

Mass and Energy Balance Modeling

Revised Final Report

Leidos Subcontract PO10234673
Contract 01-88121
SwRI® Project 25967

Prepared by:

Nicholas Deom, BS
Tyler Maris, BS
Southwest Research Institute
Chemical Engineering Department

Prepared for:

Leidos
Attn: James Ridgely
3465-A Box Hill Corporate Center Drive
Abingdon, MD 21040

Revised 4/7/2020
2/27/2020

This document has been reviewed
for OPSEC and OPSEC-sensitive
information has been removed.



S O U T H W E S T R E S E A R C H I N S T I T U T E ®
6 2 2 0 C u l e b r a R o a d • P . O . D r a w e r 2 8 5 1 0
S a n A n t o n i o , T e x a s 7 8 2 2 8 - 0 5 1 0

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

SOUTHWEST RESEARCH INSTITUTE®
6220 CULEBRA ROAD • P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78228-0510

Mass and Energy Balance Modeling

Revised Final Report
Leidos Subcontract PO10234673
Contract 01-88121
SwRI® Project 25967

Prepared by:

Nicholas Deom, BS
Tyler Maris, BS
Southwest Research Institute
Chemical Engineering Department

Prepared for:

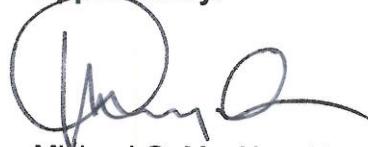
Leidos
Attn: James Ridgely
3465-A Box Hill Corporate Center Drive
Abingdon, MD 21040

Submitted by:



Nicholas Deom
Engineer
Fuels and Energy Development Section
Chemical Engineering Department

Approved by:



Michael G. MacNaughton, Ph.D., P.E.
Vice President
Chemistry and Chemical Engineering Div.

TABLE OF CONTENTS

	<u>Page</u>
1. Purpose	1
2. Anniston Trip Report.....	1
3. Summary of Provided Information and Timeline.....	4
4. Summary of Process Model and Assumptions	5
4.1 Combustion Chamber Products.....	5
4.2 Aspen Model.....	6
4.3 Detonation Chamber (120-DC).....	8
4.4 Buffer Tank (160-BT)	8
4.5 Thermal Oxidizer (310-THO)	8
4.6 Quench Vessel (340-QUE).....	9
4.7 Neutral Scrubber (350-NSC).....	10
4.8 Electrostatic Precipitator (360-WEP).....	11
4.9 Heat Exchanger (362-HEX).....	11
4.10 Separator (367-SEP).....	12
4.11 Heater (370-AHT)	12
4.12 IONEX Filtration System (400-INX).....	13
5. Results	14

APPENDICES

- A: HSC Chemistry Data
- B: CHEETAH Data
- C: Munition Characterization Table
- D: Simplified Block Flow Diagram
- E: External Review and Responses

----- Stand-alone Appendices -----

- F: SDC-1200 System
- G: SDC-2000 System

LIST OF FIGURES

<u>Figure No.</u>	<u>Page</u>
Figure 1. Aspen Model Process Flow Diagram	7
Figure 2. Static Detonation Chamber.....	8
Figure 3. Buffer Tank	8
Figure 4. Thermal Oxidizer.....	9
Figure 5. Quench Vessel	10
Figure 6. Neutral Scrubber.....	10
Figure 7. Electrostatic Precipitator.....	11
Figure 8. Heat Exchanger	12
Figure 9. Separator.....	12
Figure 10. Heater	13
Figure 11. IONEX Filtration System	13

LIST OF TABLES

<u>Table No.</u>	<u>Page</u>
Table 1. Cases Described at Anniston	2
Table 2. Munition Data (Case 1).....	14
Table 3. Feed Breakdown (Case 1).....	14
Table 4. Aspen Inputs (Case 1).....	15
Table 5. Stream Table (Case 1).....	16
Table 6. Wet Electrostatic Precipitator Stream Table (Case 1).....	17
Table 7. Munition Data (Case 2).....	18
Table 8. Feed Breakdown (Case 2).....	18
Table 9. Aspen Inputs (Case 2).....	19
Table 10. Stream Table (Case 2).....	20
Table 11. Wet Electrostatic Precipitator Stream Table (Case 2).....	21
Table 12. Munition Data (Case 3).....	22
Table 13. Feed Breakdown (Case 3).....	22
Table 14. Aspen Inputs (Case 3).....	23
Table 15. Stream Table (Case 3).....	24
Table 16. Wet Electrostatic Precipitator Stream Table (Case 3).....	25
Table 17. Munition Data (Case 4).....	26
Table 18. Feed Breakdown (Case 4).....	26
Table 19. Aspen Inputs (Case 4).....	27
Table 20. Stream Table (Case 4).....	28
Table 21. Wet Electrostatic Precipitator Stream Table (Case 4).....	29
Table 22. Munition Data (Case 5).....	30
Table 23. Feed Breakdown (Case 5).....	30
Table 24. Aspen Inputs (Case 5).....	30
Table 25. Stream Table (Case 5).....	31
Table 26. Wet Electrostatic Precipitator Stream Table (Case 5).....	32
Table 27. Munition Data (Case 6).....	33
Table 28. Feed Breakdown (Case 6).....	33
Table 29. Aspen Inputs (Case 6).....	33
Table 30. Stream Table (Case 6).....	34
Table 31. Wet Electrostatic Precipitator Stream Table (Case 6).....	35
Table 32. Munition Data (Case 7).....	36
Table 33. Feed Breakdown (Case 7).....	36
Table 34. Aspen Inputs (Case 7).....	37
Table 35. Stream Table (Case 7).....	38
Table 36. Wet Electrostatic Precipitator Stream Table (Case 7).....	39
Table 37. Munition Data (Case 8).....	40
Table 38. Feed Breakdown (Case 8).....	40
Table 39. Aspen Inputs (Case 8).....	41
Table 40. Stream Table (Case 8).....	42
Table 41. Wet Electrostatic Precipitator Stream Table (Case 8).....	43
Table 42. Munition Data (Case 9).....	44
Table 43. Feed Breakdown (Case 9).....	44
Table 44. Aspen Inputs (Case 9).....	45
Table 45. Stream Table (Case 9).....	46
Table 46. Wet Electrostatic Precipitator Stream Table (Case 9).....	47
Table 47. Munition Data (Case 10).....	48

Table 48. Feed Breakdown (Case 10).....	48
Table 49. Aspen Inputs (Case 10).....	49
Table 50. Stream Table (Case 10).....	50
Table 51. Wet Electrostatic Precipitator Stream Table (Case 10).....	51
Table 52. Munition Data (Case 11).....	52
Table 53. Feed Breakdown (Case 11).....	52
Table 54. Aspen Input (Case 11)	53
Table 55. Stream Table (Case 11).....	54
Table 56. Wet Electrostatic Precipitator Stream Table (Case 11).....	56
Table 57. Munition Data (Case 12).....	57
Table 58. Feed Breakdown (Case 12).....	57
Table 59. Aspen Inputs (Case 12).....	58
Table 60. Stream Table (Case 12).....	59
Table 61. Wet Electrostatic Precipitator Stream Table (Case 12).....	61
Table 62. Munition Data (Case 13).....	62
Table 63. Feed Breakdown (Case 13).....	62
Table 64. Aspen Inputs (Case 13).....	63
Table 65. Stream Table (Case 13).....	64
Table 66. Wet Electrostatic Precipitator Stream Table (Case 13).....	66
Table 67. Munition Data (Case 14).....	67
Table 68. Feed Breakdown (Case 14).....	67
Table 69. Aspen Inputs (Case 14).....	68
Table 70. Stream Table (Case 14).....	69
Table 71. Wet Electrostatic Precipitator Stream Table (Case 14).....	71

1. PURPOSE

Southwest Research Institute™ (SwRI) was contacted by Leidos to make mass and energy balances for a Static Detonation Chamber (SDC) and its associated gas clean-up system under several SDC loadings and at two sizes of SDC. After an external review, Leidos asked SwRI to update the report by correcting minor issues and to add four cases to the list of mass and energy balances that were estimated. The review is attached as *Appendix E* with responses from SwRI and Leidos.

For this purpose of creating the mass and energy balance calculations, simulations were needed to model the warhead destruction processes inside the SDC in order to estimate the chemical composition and volumes of the gases produced inside the SDC and their fate in the various components of the gas clean-up system. The first SDC system, referred to as the SDC 1200, is an existing process that is currently being used to which a new pollution abatement system will be added, and the second system, the SDC 2000, is a process that has been designed by Dynasafe but has not yet been built. The mass balances were needed to provide estimates of the expected emissions from the overall systems so that these estimates could be provided to appropriate environmental regulatory bodies.

This report comprises two sections: 1) the following portion (Section 2 through *Appendix E*) covers the work of the project and 2) the last two appendices, self-contained sections summarizing the mass balances for the two sizes (1200 and 2000) of SDC (*Appendices F and G*). The self-contained sections are “free-standing” so that they may be used separately. The assumptions, data sources, and methods that were used in creating and operating the Aspen Plus model of the overall systems are presented. The computer model allowed mass and energy balances to be estimated around each component in the overall system.

The work began with a site visit to Anniston, Alabama where an SDC 1200 is in operation. This was followed by the work to identify and organize the source material from which the desired sizes and loadings of components (the cases) were taken. As there were succeeding versions of these documents, a careful parsing of the information was required to extract the correct numbers to use. Next, the chemical reactions inside the SDC were modeled using two computer programs, CHEETAH® and HSC Chemistry®, These results were then combined to give the stream composition and amount that traveled into the gas clean-up system that was modeled by Aspen plus. This model was operated in accord with the defined cases selected by Leidos and reported here.

2. ANNISTON TRIP REPORT

The first step was a trip to Anniston Army Depot by SwRI personnel: Monica Brinkman, Senior Research Engineer made the trip and conferred with those knowledgeable about the SDC 1200.

- Monday, 12/09/2019
 - 13:00 arrived onsite. Jennifer Jackson escorted to B75 (office).

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

- Met with engineers onsite. Received tour of SDC system in operation.
- Briefly met with Tim Garrett. Requested SDC reactor/reaction data/assumptions from the Anniston staff.
- Met with Brian Brasher. Requested emissions data.
- Tuesday, 12/10/2019
 - Morning meeting with Brian Brasher, Mark Boden, and Harley Heaton (Dynasafe). There were also a couple observers from Anniston and some staff that called in from the Blue Grass site.
 - Requested additional process and property information to fully identify and appropriately limit the scope of the mass and energy balances.
 - Harley provided additional documentation (design documents, P&ID, updated M&E). Harley also has a list of items that he is going to send the next day. He also provided his contact information for additional questions that arise.
 - Compiled notes; generated preliminary IO (input-output diagram) and block flow diagram (BFD) from those notes. Reviewed SwRI-generated IO and BFD with Mark Boden and Harley Heaton. Unknown values marked and requested from Mark and Harley.
 - Reviewed cases needed and batch rates for each case:

Table 1. Cases Described at Anniston
Rocket **Rocket Per Batch**

	1200 Reactor	2000 Reactor
M56 GB	2	4
M56 VX	2	4
M55 GB	2	4
M55 VX	2	4

- A question that arose (that may or may not be future work) is PCBs/TSCA modelling; however, this was not needed for the current model.
- One of the challenges that we will have to further discuss is the possibility of a dynamic model. As discussed briefly on the phone last week, they introduce a

certain number of missiles per batch, which "go off" (detonate or deflagrate) at random times within a certain time period. They would like to be able to model these pulses and how the system reacts to these to capture spikes instead of averaging everything out over a given time period. They have data for when the charges go off that could be put into a model using Aspen's custom modeler, but this could be very complicated and take more time than initially desired. Another option may be bounding these events to generate a "worse-case" type scenario (e.g. if all of the charges go off at the same time). At present, a steady state model is feasible.

- Wednesday, 12/11/2019
 - Began simulation.
 - Further reviewed data and assumptions with Mark Boden:
 - Further discussed possible dynamic assumptions and needs. Since the system could need to handle pressures, flows, and temperatures for the “worst-case” scenario that all of the materials detonate or deflagrate at the same time, this should be sufficient to generate the data needed for model design.

Documents received:

- SDC Munition Charaterization.xlsx
- SDC MM5E Results Analysis.xlsx
- SDC M29 Results Analysis.xlsx
- SDC M26A Results Analysis.xlsx
- SDC M0023A Results Analysis.xlsx
- Pages from 24915-000-3DR-G01-00001 BGCAPP Design Criteria.pdf
- Cases 2-4-10 and 12 2017 FINAL.xlsx
- Cardboard tray constituents.xlsx
- CAC Presentation and SDC Chemistry.ppt
- 24915-000-3DR-G01-00001 BGCAPP Design Criteria.pdf
- 2017 CPT WC Samples.xlsx
- 07M5RHS00001s02r10 mdb rocket shear machine.pdf
- 2.2.5-2017-692514-PFD-20-B.pdf
- 2.2.5-2017-692513-PFD-10-B.pdf
- 2.2.6-2017-692515-PID-10-THO-B.pdf
- 2.2.6-2017-692518-PID-40-QUE and NSC-B.pdf
- 2.2.6-2017-692519-PID-50-WEP-B.pdf
- 2.2.6-2017-692560-PID-90-HEA-B.pdf
- 2.2.6-2017-692606-PID-80-TR-B.pdf
- 2.2.6-2017-692607-PID-81-KOS-B.pdf

- 2.2.6-2017-692608-PID-83-BWT-B.pdf
- 2.2.5-2017-1-072866-PFD1-I.pdf
- 2.2.5-2017-1-072867-PFD2-I.pdf
- 2.2.5-2017-2-090028-PFD1-A.pdf
- 2.2.5-2017-2-090029PFD2-A.pdf
- 2.2.7.1-2017-692100-Mass Balances VX-GB agents with existing SDC unit-C.pdf
- 2.2.7.1-2017-692101-Mass Balances VX-GB agents with SDC 2000 system-B.pdf
- 2.2.7.1-2017-692102-Mass Balances M55 GB drained warhead with overpack-A.pdf
- 2.2.7.1-2017-692102-Mass Balances M55 GB drained Warhead with 5% heel containerized-A.pdf

3. SUMMARY OF PROVIDED INFORMATION AND TIMELINE

Back at SwRI the work moved to engineers who had most recently used the modeling software. The folder of documents containing design information for both the SDC 1200 and SDC 2000 processes was made available to the programming staff. The computer folder had limited access to only the active project personnel. This folder contained the documents having the design information that was needed for the construction of the estimations of the SDC events and the process models in Aspen simulation software. After close inspection of the different versions of the information provided, SwRI determined that most of the documents were not the most recent after speaking with Dynasafe representatives Harley Heaton and Ajay Bidwe. The following is a timeline of the evolution of the completed mass and energy balance work:

Timeline	
Date	Actions
1/15/20	A request that eight cases be simulated was made with two cases having priority over the rest.
1/22/20	Up-to-date mechanical drawings, plot plans, and a process description is sent by Dynasafe after SwRI realizes that the provided documents were out of date.
1/24/20	The number of total cases was updated from eight to 12.
1/29/20	Design specifications were received by SwRI for the electrostatic precipitator after it was determined that they were missing.
1/31/20	First simulation was sent out and the limitation of the simulator programs used reviewed
2/4/20	The number of cases was decreased from 12 to 10.
2/5/20	Preliminary documents containing process data generated by the computer models for cases 1-6 were sent to Leidos.

Timeline (continued)	
Date	Action
2/6/20	The remaining cases 7-10 were finished and sent to Leidos.
2/20/20	All feedback regarding most recent versions of cases 1-10 received.
2/21/20	All feedback is implemented and simulations for cases 1-10 are redone.
2/28/20	First report draft sent to Leidos.
3/9/20	Second report draft and final report sent to Leidos after making requested corrections.
3/24/20	External comments on the final report received.
4/8/20	Revised final report issued with added cases and corrections/revisions.

4. SUMMARY OF PROCESS MODEL AND ASSUMPTIONS

4.1 Combustion Chamber Products

The SDC could not be modeled directly in Aspen Plus because of the limitations of the Aspen component library. Neither VX nor GB nerve agents' physical properties were available for the model. SwRI determined the products of the SDC outside of Aspen using two other modeling programs: CHEETAH and HSC Chemistry. Products of the combustion chamber were separated into two categories: 1) combustion products from the energetics inside the warhead modeled by CHEETAH and 2) the thermal decomposition products of both the cellulose from the cardboard tray and the chemical agent Modeled by HSC Chemistry. The results from CHEETAH and HSC Chemistry were then combined (Stream 1-IN) and put into Aspen Plus to model the remaining equipment in the pollution abatement system. Hence, the first two components on the Aspen flow diagram (120-DC and 16-BT) make no changes in the composition determined by the combined outputs of CHEETAH and HSC Chemistry. A more detailed explanation of CHEETAH and HSC Chemistry appears below.

CHEETAH Thermodynamic Software

The reactions of the energetics inside the warhead (and any rocket propulsion material, if present) was simulated with CHEETAH 7.0 thermodynamic software. CHEETAH is software designed to simulate and predict thermodynamic behavior of a large range of energetic materials, but most notably it is widely used to simulate the action of explosives. Using CHEETAH software, SwRI was able to produce a set of compounds that are expected to be byproducts of the explosions of the warheads being disposed of in the SDC 1200 and SDC 2000 processes. The list of inputs and the CHEETAH report with the combustion products are included as *Appendix B. CHEETAH Data*.

HSC Chemistry

The thermal decomposition of the chemical agent and cellulose were modeled in HSC Chemistry using a Gibbs chemical equilibrium model. A so-called Gibbs Reactor considers all of the chemical elements present at the start of reaction and results in the lowest-free energy state among the products of reaction. HSC Chemistry is a thermodynamic software program for the purpose of simulating such idealized chemical reactions. Both the inputs and outputs of this simulation are in *Appendix A. HSC Chemistry Data*. Composition information of each warhead case was compiled from data provided by the client and from the literature. This information was organized as the Munitions Characterization Table and is included in this report as *Appendix C. Munition Characterization Table*.

4.2 Aspen Model

For the purpose of simplifying the process model, only unit operations (gas clean-up components) which affect the stack-gas composition or were in the direct flow path of the exhaust gases were included in the model. Stream names in the Aspen model reflect the stream names that were given to streams in the Dynasafe terminology provided to SwRI. The model does not take into account heat losses that occur between unit operations. It is assumed that appropriate equipment that regulates temperature will be installed where needed for this purpose such as heat tracing and/or insulation.

In Aspen Plus, the ELECNRTL property method set was used as the global property method to best model the ionic reactions that occur within the Quench Vessel (340-QUE) and the Neutral Scrubber (350-NSC). ELECNRTL was chosen because the model's computation of these unit operations simulate low-pressure electrolyte reactions well. For the portions of the simulation that were not simulating electrolyte interactions, the NRTL property method was used. The NRTL method is a good, general-purpose method for simulating low-pressure (< 10 bar) systems with both liquid-liquid and vapor-liquid interactions.

Outputs from both CHEETAH and HSC Chemistry that did not appear in molar concentrations above 1 part per billion (ppb) were removed before being put into Aspen to decrease the complexity of the simulation and to prevent potential chemical compound property generation issues in Aspen. The 1 ppb threshold was chosen because it is smaller than the exposure limit of all compounds being considered in the simulation. In addition to compounds appearing in concentrations less than 1 ppb, the following compounds were also removed to allow the Aspen model to run without issue: POF₃, CHNO, HCN, HNO₂, H₂F₂. These compounds were removed because Aspen's component library does not contain the information needed for Aspen to generate property data, and experimental data could not be found for these compounds. Removal of these compounds from the simulation should not greatly affect the results because the largest concentration of any of these compounds was estimated to be 106 parts per million (ppm). This number was calculated by dividing the number of kmol of each of the removed compounds produced by HSC Chemistry and dividing each by the total number of kmol to get the parts per million on a molar basis. A simplified block flow diagram of the process as modeled appears in *Appendix D. Simplified Block Flow Diagram*, and a process flow diagram of the process in Aspen can be viewed on the next page in Figure 1.

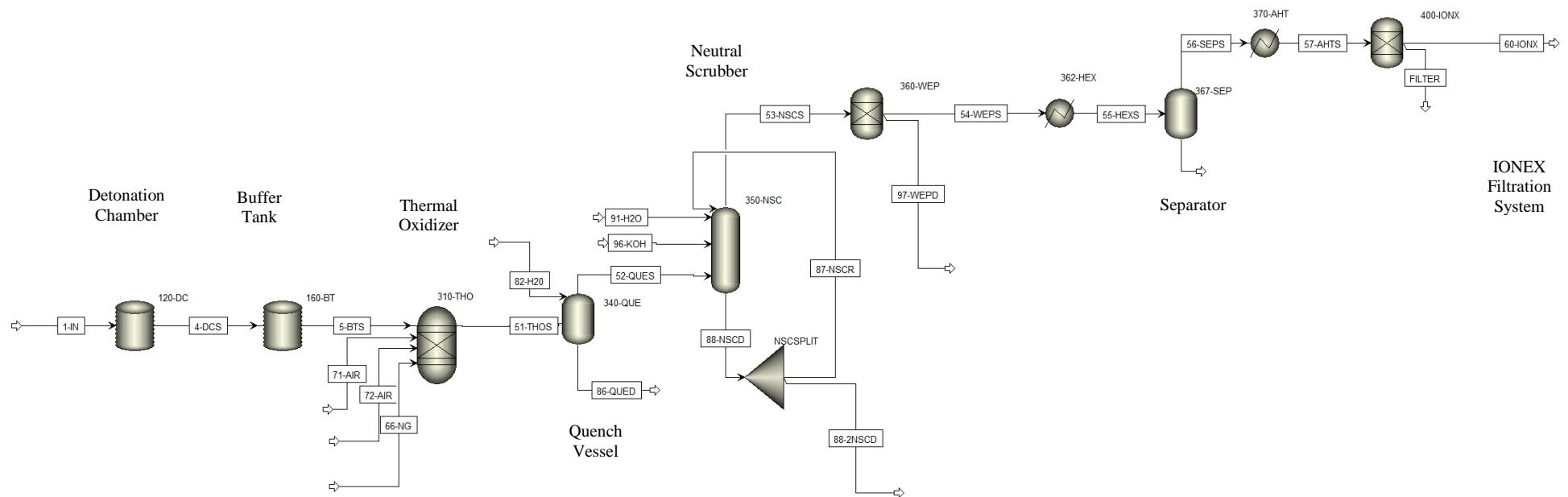


Figure 1. Aspen Model Process Flow Diagram

4.3 Detonation Chamber (120-DC)

The static detonation chamber was represented in Aspen as a simple vessel, Figure 2. Within the model, the vessel is used only as a visual representation of the detonation chamber and does not affect the temperature, pressure, or composition of the gas stream. Those properties in each case were either controlled by design or supplied from the combination of the CHEETAH and HSC Chemistry modeling software results.

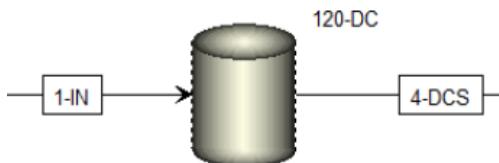


Figure 2. Static Detonation Chamber

4.4 Buffer Tank (160-BT)

Similar to the detonation chamber, the buffer tank, Figure 3, was modeled as a vessel in Aspen. The vessel was assumed to have an internal temperature of 550 °C and pressure of 29 kPag. In practice, the pressure entering the buffer tank is variable, but the tank is followed by an orifice plate that dampens pressure changes. For the purpose of the simulation, the buffer tank does not affect the temperature, pressure, or composition of the gas stream, but the stream leaving the buffer tank (Stream 5) has the correct pressure, temperature, and composition by design. The buffer tank from the Aspen process flow diagram can be found in Figure 3 below. The stream designations are as they appeared in the background materials obtained from Anniston.

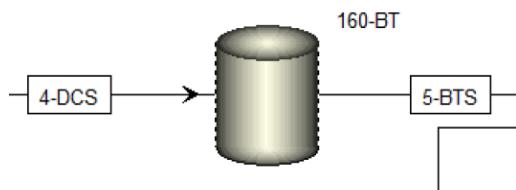


Figure 3. Buffer Tank

4.5 Thermal Oxidizer (310-THO)

The functional portion of the Aspen simulation starts at the thermal oxidizer. The thermal oxidizer was modeled as a Gibbs reactor at 982 °C and -1.0 kPag. The Gibbs reactor produced the equilibrium composition of gases from combining Streams 5, 71, and 66 at the design temperature and pressure. The efficiency of the burner package for complete combustion is not considered in the production of NO or NO₂. The products of the thermal oxidizer are based on equilibrium Gibbs free energy minimization. The model assumes that only Stream 71 is providing air to the burner package. The model simulates the burner package in the thermal oxidizer as a stream of air (71) [Numbers in parentheses are stream numbers.] and stream of natural gas (66) entering the oxidizer.

This ensures that the exhaust gases produced from the burner package were included in the final emissions estimates.

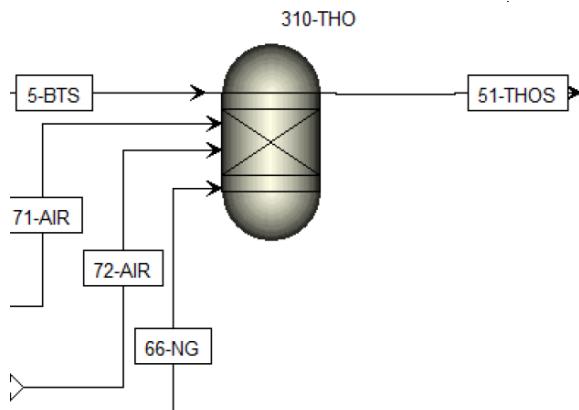
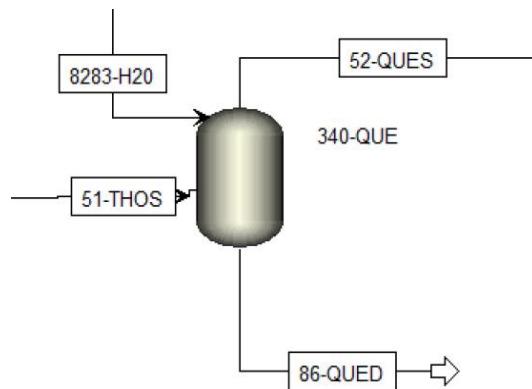


Figure 4. Thermal Oxidizer

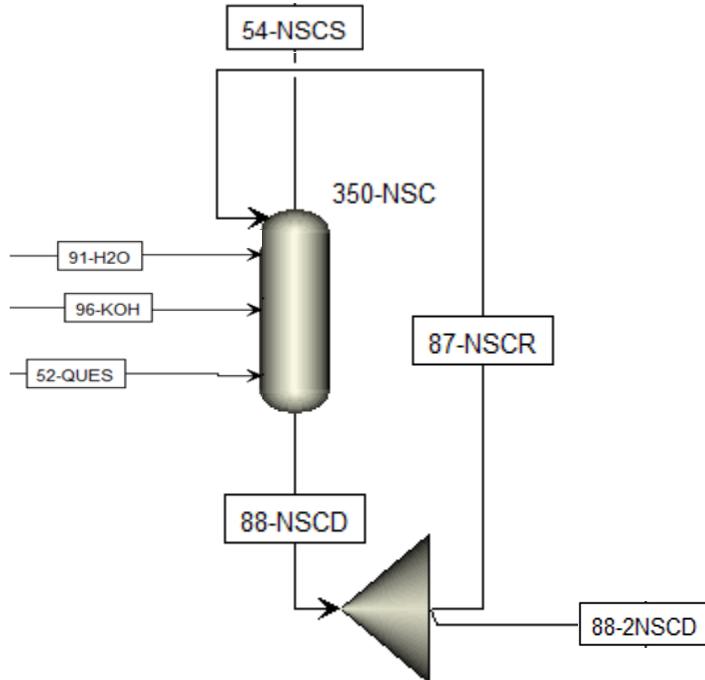
4.6 Quench Vessel (340-QUE)

The quench vessel, shown in Figure 5, was modeled as a flash drum at 81 °C and -4.2 kPag. A flash drum was chosen over a RadFrac column, also available in Aspen, because of the design of the quench vessel. The flash drum Aspen unit does not consider size or efficiency with respect to time; it outputs the equilibrium concentrations of dissolved gasses in water based on Henry's Law coefficients. The equilibrium assumption was extended to heat transfer. The liquid stream and vapor stream, 86-QUED and 52-QUES, leave the unit at the same temperature and pressure. For these reasons, the Quench Vessel gaseous streams were idealized in the model. In practice, the Quench Vessel will likely not be able to remove as much of the phosphorous or sulfur compounds compared with its simulation counterpart. The model assumes that no external heating or cooling occurs and that the only source of heat transfer is the water being pumped into the quench vessel at 9405 kg/hr and 80 °C. The process description, "Prototype Chemical Munition Destruction System in Support of Assembled Chemical Weapons Alternatives (ACWA) Chemical Agent Destruction Pilot Plan Blue Grass Arm Depot, Kentucky" (issued 2019.10.11), includes a droplet separator immediately down-stream of the Quench Vessel that recycles liquid water back into the Quench Vessel. Aspen allows for liquid entrainment to be specified for flash drums. The liquid entrainment factor was assumed to be 1%.

**Figure 5. Quench Vessel**

4.7 Neutral Scrubber (350-NSC)

The neutral scrubber, shown in Figure 6, was modeled as a RadFrac column with four stages. Operating conditions within the scrubber were assumed to be at 81 °C and -4.8 kPag. Between stages two and four, there is 15 mm Pall Ring packing with a height of 3000 mm. Stream 51 was expected to contain a collection of corrosive and highly acidic components. The scrubber neutralizes these components with a combination of scrubbing water and 30% KOH solution, and was designed to run at a neutral pH (6-7 pH). Recycle as shown in Figure 6.

**Figure 6. Neutral Scrubber**

4.8 Electrostatic Precipitator (360-WEP)

The electrostatic precipitator, shown in Figure 7, was modeled using the electrostatic precipitator block in a separate Aspen simulation with 55 tubes, each with a diameter of 250mm. The model predicted that most, if not all, of the compounds that the electrostatic precipitator is supposed to remove, mainly phosphoric acid, were either neutralized or carried away inside of the quench vessel or scrubber. To ensure that the precipitator is capable of removing these compounds, it was modeled in a separate simulation to verify its intended operation. In the test case, the inlet to the precipitator (Stream 53) is a copy of the effluent stream exiting the neutral scrubber (Stream 54) with the maximum amount of phosphoric acid produced in the model for each case added to the stream. This way the model simulated a worst case scenario where phosphoric acid is not neutralized prior to entering the electrostatic precipitator and this model showed that it was capable handling the quantities of phosphoric acid that the basic model was predicting were otherwise removed. It should be mentioned that the electrostatic precipitator block in Aspen simulation software is a dry electrostatic precipitator and requires a particle size density of the phosphoric acid. The efficiency of the electrostatic precipitator is based on loading area voltage, precipitation area voltage, and particle size density (PSD) of the phosphoric acid. With a loading area voltage of 135kV, precipitation area voltage of 78kV, the electrostatic precipitator was consistently able to remove solid phosphoric acid between 0.5 μm and 1 μm with an efficiency of 99.9999999% (10 nines) and particles between 0.1 μm and 1 μm with an efficiency of 99.9999% (6 nines). For the simulation, the particle size was assumed to be 0.99-1 μm . The WEP is also represented in the main Aspen simulation as a separator, which removes the water and remaining phosphorus-containing compounds from the gas stream that would be removed if the Aspen electrostatic precipitator block could be put into its place.

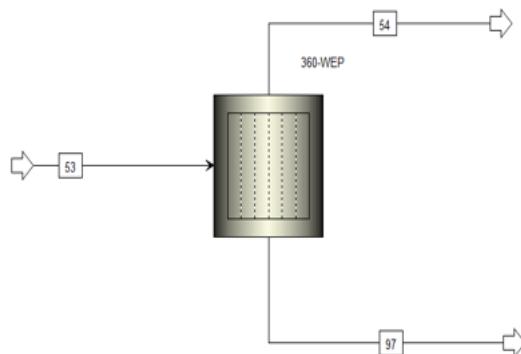
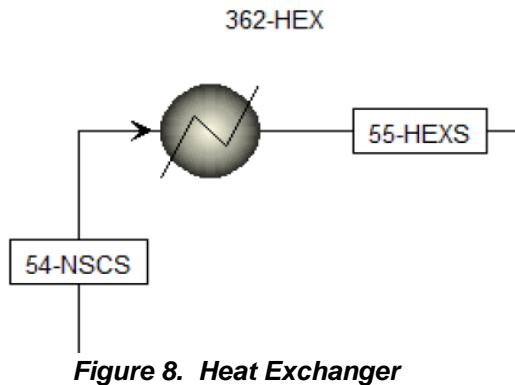


Figure 7. Electrostatic Precipitator

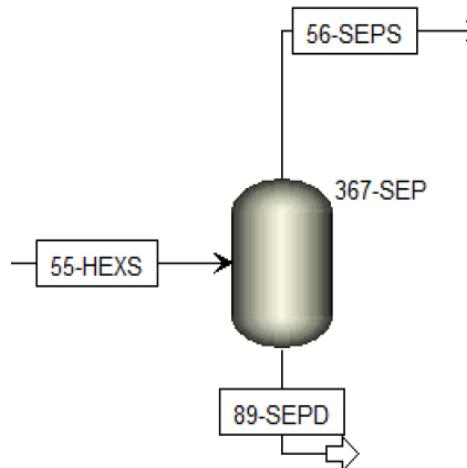
4.9 Heat Exchanger (362-HEX)

The heat exchanger, shown in Figure 8, that cooled the gas stream exiting the electrostatic precipitator was assumed to have an 80/20 wt% mixture of water and propylene glycol with a temperature of 10 °C on the cooling side of the exchanger. The effective heat transfer area used in the model is 95.9 m³ as specified by the mechanical drawing in the design documents. The fouling factor was assumed to be 0.85. The heat exchanger was assumed to have a hot-side inlet temperature of 81 °C and an outlet temperature of 45 °C.

**Figure 8. Heat Exchanger**

4.10 Separator (367-SEP)

The separator after 362-HEX, shown in Figure 9, was modeled as a flash drum, because there is not a unit operation block in Aspen that simulates a screened separator/decanter. Because an efficiency was not specified in the mechanical drawings or any of the other provided document, the model assumed that a large majority of the water in the gas stream was condensed and removed as Stream 89 with trace amounts of the other stream components. The model also assumed that no additional heating or cooling occurred within or outside of the separator.

**Figure 9. Separator**

4.11 Heater (370-AHT)

The 370-HT heater, shown in Figure 10, was modeled as a general Aspen heater block. The heater was assumed to have an inlet temperature of 45 °C and an outlet temperature of 60 °C. It is also assumed that the exchanger decreased the relative humidity of the process gas to 50 % or below, and it served no other purpose.

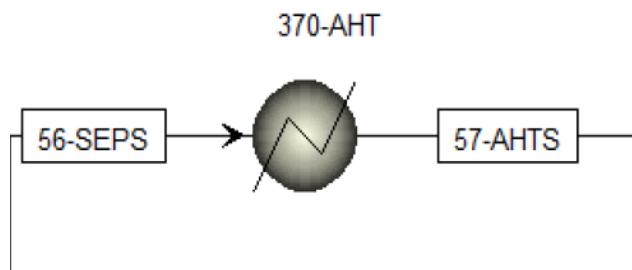


Figure 10. Heater

4.12 IONEX Filtration System (400-INX)

The IONEX filtration system, shown in Figure 11, was modeled as an Aspen separator. Aspen does not currently have unit operation blocks with the intended purpose of simulating gas-gas filtration. The model did not take into consideration the particulate that was intended to be captured by the fiberglass and HEPA filters, in the IONEX filtration system. Because the model is not simulating particulate filtration, a single separator was used to model the activated carbon beds inside the filtration system. The paper from Shuang-chen Ma, et al¹ claims that NO_x adsorption efficiency is up to 97%, and the SO_x adsorption efficiency is up to 99% in an activated carbon bed with a 500 mm length as in the IONEX system. Although the activated carbon beds in the IONEX filtration system are larger than the ones in the article, the simulation does not take into account any NO_x, SO_x, or CO_x adsorption by the beds with the assumption than any adsorption would either be minimal, or the adsorption capacity of the activated carbon beds would be quickly used up.

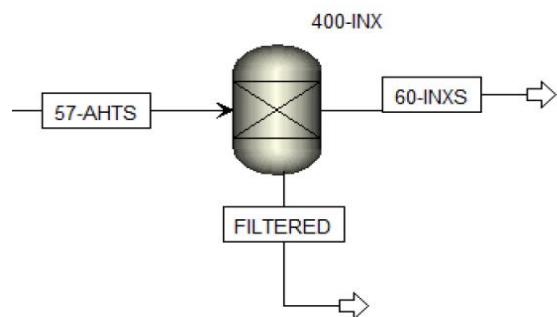


Figure 11. IONEX Filtration System

¹ Shuang-chen Ma, et al. "Experimental study on removals of SOx and NOx using adsorption of activated carbon/microwave desorption." *Journal of the Air & Waste Management Association*.
<https://doi.org/10.1080/10962247.2012.695320>

5. RESULTS

Section 5 of this report contains the Aspen Plus simulation results for Case 1 through Case 14. Each case has its own section, and the details including which unit (SDC-1200 or SDC-2000), type of munition, and feed rate of munitions are listed for each case on the case coversheet. Each case contains five tables: Munition Data, Feed Breakdown, Aspen Inputs, Stream Table, and Wet Electrostatic Precipitator Stream Table. The Munition Data table shows information about the munition in each case, most notably whether the munition is filled, what type of agent it contains, and the total number of munitions being simulated. The Feed Breakdown table shows a detailed list of components that make up the munition being considered and the mass flow rate of each component. The Aspen Inputs table shows a breakdown of the chemical compounds that were used as inputs in Aspen Plus. The Stream Table shows the simulation results for each stream that is represented in *Figure 1. Aspen Model Process Flow Diagram*. Streams leaving the diagram are blank on the TO line of the table. Finally, the Wet Electrostatic Precipitator Stream Table shows the simulation results for the Wet Electrostatic Precipitator streams.

Case 1
Unit: SDC 1200
Munition: M56 VX Warhead Drained (5% Heel)
Feed Rate: 6 pieces/hr

Table 2. Munition Data (Case 1)

Per Case	M56 WH
Fill	Drained
Case	1
Agent	VX-1200
Pieces/Feed	2
Feed/hr	3
Total Pieces	6
Total Cardboard (lbs)	24

Table 3. Feed Breakdown (Case 1)

Part Name	lbs/piece	kg/piece	lbs/hr	kg/hr
Agent	0.505	0.23	3.03	1.37
Burster (M34)	2.5	1.13	15	6.80
Burster 2 (M36)	0.64	0.29	3.84	1.74
Suppl Charg (TNT)	0	0	0	0
Fuze (M417)	0.04	0.02	0.24	0.11
Propellant (M28)	0	0	0	0
Primer (M62)	0	0	0	0
Cardboard box (cellulose) (lbs)	4	1.81	24	10.89
Overpack material (SRC)	0	0	0	0
Other scrap (rckt shell-Al & steel)	-	-	-	-

Table 4. Aspen Inputs (Case 1)

Component	kmol/hr
N2	6.41E+00
O2	1.18E+00
CO2	5.15E-01
H2O	4.39E-01
H2SO4	5.14E-03
H3PO4	3.05E-05
P4O10	1.28E-03
NO	1.73E-05
P2O5	1.90E-05
NO2	4.19E-06
H2	2.65E-02
CO	7.60E-02
NH3	2.37E-03
CH4	2.90E-02
C2H6	7.41E-04
C2H4	4.75E-04
CH3OH	4.07E-05
CH2O2	3.73E-05
C2H6O	1.13E-06
C3H8	2.07E-05
Benzene	1.63E-05
C2H2	1.13E-05
C (ash/soot)	1.66E-02

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Table 5. Stream Table (Case 1)

*Note: the “Filter Stream” represents the material collected by the IONEX filtration system (far right)

Table 6. Wet Electrostatic Precipitator Stream Table (Case 1)

Stream No.		53	54	97
From		350-NSC	360-WEP	360-WEP
To		360-WEP	362-HEX	
Phase		Vapor	Vapor	Solid
Mole Flows	kmol/hr	122	109	12.985
Volume Flow	l/min	54780	54779	4.030
Mass Flows	kg/hr	2880	2646	234.46
Temperature	°C	78	78	78
Pressure	kPag	-4.8	-4.8	
Enthalpy	kW	-4740	-3721	-1019
Composition				
N2	kg/hr	1406	1406	1.13E-01
O2	kg/hr	163	163	1.52E-02
CO2	kg/hr	194	194	1.22E-01
H2O	kg/hr	1116	882	2.34E+02
CO	kg/hr	2.83E-05	2.83E-05	2.40E-09
H2	kg/hr	2.22E-06	2.22E-06	1.77E-11
NO	kg/hr	3.77E-01	3.77E-01	1.10E-05
NO2	kg/hr	3.04E-03	3.00E-03	3.55E-05
SO2	kg/hr	4.36E-06	4.33E-06	2.81E-08
HF	kg/hr			
H3PO4	kg/hr	5.04E-01	2.78E-08	5.04E-01

Case 4

Unit: SDC 1200

Munition: M56 GB Warhead Drained (5% Heel)

Feed Rate: 6 pieces/hr

Table 17. Munition Data (Case 4)

Per Case	M56 WH
Fill	Drained
Case	4
Agent	GB
Pieces/Feed	2
Feed/hr	3
Total Pieces	6
Total Cardboard (lbs)	24

Table 18. Feed Breakdown (Case 4)

Part Name	lbs/piece	kg/piece	lbs/hr	kg/hr
Agent	0.538	0.24	3.23	1.46
Burster (M34)	2.5	1.13	15	6.80
Burster 2 (M36)	0.64	0.29	4	1.74
Suppl Charg (TNT)	0	0	0	0
Fuze (M417)	0.04	0.02	0.24	0.11
Propellant (M28)	0	0	0	0
Primer (M62)	0	0	0	0
Cardboard box (cellulose) (lbs)	4	1.81	24	10.89
Overpack material (SRC)	0	0	0	0
Other scrap (rckt shell-Al & steel)	-	-	-	-

Table 19. Aspen Inputs (Case 4)

Component	kmol/hr
N2(g)	6.41E+00
O2(g)	1.21E+00
CO2(g)	5.00E-01
H2O(g)	4.24E-01
HF(g)	1.04E-02
P4O10(g)	2.61E-03
NO(g)	1.76E-05
NO2(g)	4.29E-06
H2(g)	2.65E-02
CO(g)	7.60E-02
NH3(g)	2.37E-03
ch4	2.90E-02
c2h6	7.41E-04
c2h4	4.75E-04
ch3oh	4.07E-05
ch2o2	3.73E-05
c2h6o	1.13E-06
c3h8	2.07E-05
benzene	1.63E-05
c2h2	1.13E-05
C	1.66E-02

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Table 20. Stream Table (Case 4)

*Note: the “Filter Stream” represents the material collected by the IONEX filtration system (far right)

Table 21. Wet Electrostatic Precipitator Stream Table (Case 4)

Stream No.		53	54	97
From		350-NSC	360-WEP	360-WEP
To		360-WEP	362-HEX	
Phase		Vapor	Vapor	Solid
Mole Flows	kmol/hr	117	109	8.222
Volume Flow	l/min	54769	54769	2.556
Mass Flows	kg/hr	2794	2645	149.03
Temperature	°C	78	78	78
Pressure	kPag	-4.8	-4.8	
Enthalpy	kW	-4363	-3716	-647
Composition				
N2	kg/hr	1406	1406	7.16E-02
O2	kg/hr	164	164	9.68E-03
CO2	kg/hr	192	192	7.66E-02
H2O	kg/hr	1030	882	1.48E+02
CO	kg/hr	2.81E-05	2.81E-05	1.51E-09
H2	kg/hr	2.21E-06	2.21E-06	1.12E-11
NO	kg/hr	3.78E-01	3.78E-01	6.96E-06
NO2	kg/hr	3.01E-03	2.99E-03	2.24E-05
SO2	kg/hr	3.60E-06	3.59E-06	1.47E-08
HF	kg/hr	1.20E-07	1.19E-07	1.47E-09
H3PO4	kg/hr	1.02E+00	5.63E-08	1.02E+00

Case 5
Unit: SDC 1200
Munition: 155mm VX Projectile Undrained
Feed Rate: 4 pieces/hr

Table 22. Munition Data (Case 5)

Per Case	M56 WH
Fill	Undrained
Case	5
Agent	VX
Pieces/Feed	2
Feed/hr	2
Total Pieces	4
Total Cardboard (lbs)	16

Table 23. Feed Breakdown (Case 5)

Part Name	lbs/piece	kg/piece	lbs/hr	kg/hr
Agent	6	2.72	24.00	10.89
Burster (M34)	-	-	-	-
Burster 2 (M36)	-	-	-	-
Suppl Charg (TNT)	0	0	0	0
Fuze (M417)	-	-	-	-
Propellant (M28)	0	0	0	0
Primer (M62)	0	0	0	0
Cardboard box (cellulose) (lbs)	4	1.81	16	7.26
Overpack material (SRC)	0	0	0	0
Other scrap (rckt shell-Al & steel)	-	-	-	-

Table 24. Aspen Inputs (Case 5)

Component	kmol/hr
N2	6.34E+00
CO2	7.16E-01
O2	6.28E-01
H2O	4.47E-01
H2SO4	4.07E-02
H3PO4	5.78E-04
P4O10	9.82E-03
P2O5	4.29E-04
NO	1.27E-05
NO2	2.26E-06

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Table 25. Stream Table (Case 5)

*Note: the “Filter Stream” represents the material collected by the IONEX filtration system (far right)

Table 26. Wet Electrostatic Precipitator Stream Table (Case 5)

Stream No.		53	54	97
From		350-NSC	360-WEP	360-WEP
To		360-WEP	362-HEX	
Phase		Vapor	Vapor	Solid
Mole Flows	kmol/hr	117	108	8.206
Volume Flow	l/min	54596	54596	2.569
Mass Flows	kg/hr	2786	2635	151.17
Temperature	°C	78	78	78
Pressure	kPag	-4.8	-4.8	
Enthalpy	kW	-4385	-3731	-654
Composition				
N2	kg/hr	1404	1404	7.13E-02
O2	kg/hr	150	150	8.84E-03
CO2	kg/hr	199	199	7.88E-02
H2O	kg/hr	1029	882	1.47E+02
CO	kg/hr			
H2	kg/hr			
NO	kg/hr	3.62E-01	3.62E-01	6.63E-06
NO2	kg/hr	2.76E-03	2.74E-03	2.04E-05
SO2	kg/hr	4.40E-02	4.38E-02	1.79E-04
HF	kg/hr			
H3PO4	kg/hr	3.99E+00	2.03E-07	3.99E+00

Case 11
Unit: SDC 1200
Munition: M55 VX Rocket Undrained
(Warhead and Motor)
Feed Rate: 3 pieces/hr

Table 52. Munition Data (Case 11)

Per Case	M56 WH
Fill	Undrained
Case	11
Agent	VX-1200
Pieces/Feed	1
Feed/hr	3
Total Pieces	3
Total Cardboard (lbs)	12

Table 53. Feed Breakdown (Case 11)

Part Name	lbs/piece	kg/piece	lbs/hr	kg/hr
Agent	10.1	4.58	30.30	13.74
Burster (M34)	2.5	1.13	7.50	3.40
Burster 2 (M36)	0.64	0.29	1.92	0.87
Suppl Charg (TNT)	0	0	0	0
Fuze (M417)	0.040	0.018	0.12	0.05
Propellant (M28)	0	0	0.00	0.00
Primer (M62)	0.000	0.000	0.000	0.000
Cardboard box (cellulose) (lbs)	4	1.81	12.00	5.44
Overpack material (SRC)	0	0	0.00	0.00
Other scrap (rckt shell-Al & steel)	0	0	0.00	0.00

Table 54. Aspen Input (Case 11)

Component	kmol/hr
N2	6.39E+00
O2	4.89E-01
CO2	7.95E-01
H2O	8.04E-01
CO	3.80E-02
H2	1.32E-02
NO	1.12E-05
NO2	1.77E-06
NH3	1.19E-03
H2SO4	5.14E-02
P4O10	1.27E-02
H3PO4	7.94E-04
HCN	7.80E-06
C	8.28E-03
CH4	1.45E-02
C2H2	5.63E-06
C2H4	2.37E-04
C2H6	3.70E-04
CH2O2	1.87E-05
C2H5OH	5.67E-07
C3H8	1.04E-05
CH3OH	2.04E-05
ACETONE	2.37E-07
BENZENE	8.17E-06

Table 55. Stream Table (Case 11)

Stream No.	1	4	5	51	52	53	54	55	56	57	60	66	71	72	82	86	87	88	88-2	89	91	96	97	Filter *		
From		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX (STACK)				340-QUE	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP			360-WEP	400-IONX			
To		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX (STACK)	310-THO	310-THO	310-THO	340-QUE	350-NSC	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP		350-NSC	350-NSC			
Phase	Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Mixed	Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Filter		
Mole Flows	kmol/hr	8.62	8.62	8.62	67.9	117	109	108	66.0	66.0	3.80	55.4	0.0	522.1	472.5	830.5	923.0	92.5	42.1	83.3	0.5	0.5	0.1			
Volume Flow	l/min	9773	9773	9773	117676	59020	54596	54690	30522	30572	32123	32091	439	21587	0	161	146	257	286	29	13	25	0	0		
Mass Flows	kg/hr	254	254	254	1915	2803	2642	2633	1875	1874	61	1599	0	9405	8516	15000	16671	1671	758	1500	10	9	1			
Temperature	C	550	550	550	982	80	78	78	45	45	60	60	20	20	20	80	80	80	80	80	45	20	20	78	60	
Pressure	kPag	-1.0	-1.0	-1.0	-1.0	-4.2	-4.8	-5.4	-6.0	-6.2	-6.5	-6.5	250	3.0	5.0	260.0	-4.2	-4.8	-4.8	-4.8	-6.2	260.0	150.0	-4.8	-6.5	
Enthalpy	kW	-113.6	-113.6	-113.6	-490	-4358	-3772	-3739	-4274	-948	-940	-936	-79.3	-2.2	0.0	-40873.8	-37005.9	-65059.2	-72308.8	-7249.6	-3326.0	-6623.5	-39.5	-38.6	-5.3	
Composition																										
N2	kg/hr	179	179	179	1406	1406	1406	1406	1406	1406	1406	1406	1227	0	0	0	0	0	0	0	0	0	0	0		
O2	kg/hr	15.6	15.6	15.6	144	144	144	144	144	144	144	144	373	0	0	0	0	0	0	0	0	0	0	0		
CO2	kg/hr	35.0	35.0	35.0	205	205	205	205	205	205	205	205			0.18	0.31	0.34	0.03	0.05							
H2O	kg/hr	14.49	14.49	14.49	152	1046	888	879	879	879	121	121	120		9405	8510	14944	16609	1665	758	1500	7.28	8.88	1.21		
H3O+	kg/hr	2.32E-09	2.32E-09	2.32E-09										1.83E-03			8.97E-05	5.57E-01	1.25E-04	1.39E-04	1.39E-05	1.83E-03	2.35E-06	1.03E-17	8.09E-08	7.08E-09
OH-	kg/hr	2.68E-19	2.68E-19	2.68E-19										4.14E-09			8.02E-05	1.23E-08	2.18E-04	2.42E-04	2.43E-05	4.13E-09	2.10E-06	9.46E-01	7.24E-08	6.33E-09
CO	kg/hr	1.06E+00	1.06E+00	1.06E+00	3.16E-05	3.16E-05	3.16E-05	3.16E-05	3.16E-05	3.16E-05	3.15E-05	3.15E-05	3.15E-05			7.96E-08	1.39E-07	1.54E-07	1.55E-08	2.40E-08						
CO3--	kg/hr	1.33E-33	1.33E-33	1.33E-33										1.43E-10			1.13E-12	2.64E-04	2.93E-04	2.94E-05	1.43E-10					
HCO3-	kg/hr	1.20E-17	1.20E-17	1.20E-17										2.75E-04			3.92E-05	7.01E-01	7.79E-01	7.81E-02	2.74E-04					
H2CO3	kg/hr																									
H2	kg/hr	2.67E-02	2.67E-02	2.67E-02	2.45E-06	2.45E-06				1.29E-10	2.24E-10	2.49E-10	2.50E-11	1.94E-11												
NO	kg/hr	3.36E-04	3.36E-04	3.36E-04	3.54E-01	3.54E-01				4.84E-05	8.51E-05	9.46E-05	9.48E-06	6.32E-05												
NO2	kg/hr	8.15E-05	8.15E-05	8.15E-05	3.61E-03	2.66E-03	2.47E-03	2.47E-03	2.47E-03	2.06E-03	2.06E-03	2.06E-03				9.45E-04	1.69E-03	1.88E-03	1.88E-04	4.13E-04						
NH3	kg/hr	2.02E-02	2.02E-02	2.02E-02	3.50E-13																					
H2S	kg/hr																									
SO2	kg/hr																									
SO4--	kg/hr	2.72E-21	2.72E-21	2.72E-21													6.38E-02	1.77E-03	1.97E-03	1.98E-04	8.62E-05					
SO3--	kg/hr																3.24E-06									
HSO3-	kg/hr																1.05E-06	3.99E+00	4.44E+00	4.45E-01	2.33E-06					
HSO4-	kg/hr	1.23E-08	1.23E-08	1.23E-08										7.45E-03			1.10E-01	3.14E+01	3.49E+01	3.50E+00	7.45E-03					
H2SO4	kg/hr	5.04E+00	5.04E+00	5.04E+00	8.46E-06	5.20E-21											5.10E-06									
K2SO3	kg/hr																									
K2SO4	kg/hr																									
P4O10	kg/hr	3.59E+00	3.59E+00	3.59E+00																						
P4O6	kg/hr																									
PO4---	kg/hr	9.72E-48	9.72E-48	9.72E-48														2.39E-14								
HPO4--	kg/hr	6.75E-30	6.75E-30	6.75E-30														5.63E-05								
H2PO4-	kg/hr	1.59E-14	1.59E-14	1.59E-14														2.71E+00								
H3PO4	kg/hr	7.78E-02	7.78E-02	7.78E-02	5.04E+00	1.26E-14												2.30E+00								
K2HPO4	kg/hr					</																				

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Stream No.	1	4	5	51	52	53	54	55	56	57	60	66	71	72	82	86	87	88	88-2	89	91	96	97	Filter *
From		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX					340-QUE	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP		360-WEP	400-IONX	
To		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX	310-THO	310-THO	310-THO	340-QUE						350-NSC	350-NSC		
HF	kg/hr																							
F-	kg/hr																							
HCL	kg/hr																							
CL-	kg/hr																							
KCL	kg/hr																							
KOH	kg/hr																							
K+	kg/hr																							
K	kg/hr																							
MGO	kg/hr																							
MG	kg/hr																							
NH4+	kg/hr	8.64E-11	8.64E-11	8.64E-11																				
HCOO-	kg/hr	1.95E-14	1.95E-14	1.95E-14																				
NH2COO-	kg/hr	1.86E-22	1.86E-22	1.86E-22																				
CN-	kg/hr	7.73E-24	7.73E-24	7.73E-24																				

*Note: the "Filter Stream" represents the material collected by the IONEX filtration system (far right)

Table 56. Wet Electrostatic Precipitator Stream Table (Case 11)

Stream No.		53	54	97
From		350-NSC	360-WEP	360-WEP
To		360-WEP	362-HEX	
Phase		Vapor	Vapor	Solid
Mole Flows	kmol/hr	109	108	0.446
Volume Flow	l/min	54553	54556	0.168
Mass Flows	kg/hr	2647	2635	12
Temperature	°C	78	78	78
Pressure	kPag	-4.8	-4.8	
Enthalpy	kW	-3791	-3742	-49
Composition				
N2	kg/hr	1406	1406	3.45E-03
O2	kg/hr	144	144	4.10E-04
CO2	kg/hr	205	205	3.93E-03
H2O	kg/hr	888	881	7.11E+00
CO	kg/hr	3.16E-05	3.16E-05	8.18E-11
H2	kg/hr	2.45E-06	2.45E-06	5.98E-13
NO	kg/hr	3.54E-01	3.54E-01	3.14E-07
NO2	kg/hr	2.47E-03	2.47E-03	8.91E-07
SO2	kg/hr	1.79E-02	1.79E-02	3.54E-06
HF	kg/hr			
H3PO4	kg/hr	5.04E+00	2.52E-07	5.04E+00

Case 14
Unit: SDC 1200
Munition: M55 VX Rocket Undrained
(Warhead and Motor)
Feed Rate: 6 pieces/hr

Table 67. Munition Data (Case 14)

Per Case	M56 WH
Fill	Undrained
Case	14
Agent	GB-1200
Pieces/Feed	2
Feed/hr	3
Total Pieces	6
Total Cardboard (lbs)	24

Table 68. Feed Breakdown (Case 14)

Part Name	lbs/piece	kg/piece	lbs/hr	kg/hr
Agent	10.75	4.88	64.50	29.26
Burster (M34)	2.5	1.13	15.00	6.80
Burster 2 (M36)	0.64	0.29	3.84	1.74
Suppl Charg (TNT)	0	0	0	0
Fuze (M417)	0.040	0.018	0.24	0.11
Propellant (M28)	0	0	0.00	0.00
Primer (M62)	0.000	0.000	0.000	0.000
Cardboard box (cellulose) (lbs)	4	1.81	24.00	10.89
Overpack material (SRC)	0	0	0.00	0.00
Other scrap (rckt shell-Al & steel)	0	0	0.00	0.00

Table 69. Aspen Inputs (Case 14)

Component	kmol/hr
N2	6.41E+00
O2	4.21E-13
CO2	1.29E+00
H2O	1.09E+00
CO	7.60E-02
H2	2.65E-02
NO	1.44E-09
NO2	3.41E-16
NH3	2.37E-03
P4O10	9.86E-03
PH3	4.02E-02
H3PO4	1.20E-01
HCN	1.56E-05
C	1.66E-02
CH4	2.90E-02
C2H2	1.13E-05
C2H4	4.75E-04
C2H6	7.41E-04
CH2O2	3.73E-05
C2H5OH	1.13E-06
C3H8	2.07E-05
CH3OH	4.07E-05
ACETONE	4.75E-07
BENZENE	1.63E-05
HF	1.83E-01

Table 70. Stream Table (Case 14)

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Stream No.	1	4	5	51	52	53	54	55	56	57	60	66	71	82	86	87	88	88-2	89	91	96	97	Filter *	
From		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX				340-QUE	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP		360-WEP	400-IONX		
To	120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX		310-THO	310-THO	340-QUE		350-NSC	NSCSPLIT		350-NSC	350-NSC				
F-	kg/hr	2.27E-13	2.27E-13	2.27E-13																				
HCL	kg/hr																							
CL-	kg/hr																							
KCL	kg/hr																							
KOH	kg/hr																							
K+	kg/hr																							
K	kg/hr																							
MGO	kg/hr																							
MG	kg/hr																							
NH4+	kg/hr	6.31E-07	6.31E-07	6.31E-07																				
HCOO-	kg/hr	1.34E-11	1.34E-11	1.34E-11																				
NH2COO-	kg/hr	3.20E-19	3.20E-19	3.20E-19																				
CN-	kg/hr	5.29E-21	5.29E-21	5.29E-21																				
HS-	kg/hr																							
S--	kg/hr																							

*Note: the "Filter Stream" represents the material collected by the IONEX filtration system (far right)

Table 71. Wet Electrostatic Precipitator Stream Table (Case 14)

Stream No.		53	54	97
From		350-NSC	360-WEP	360-WEP
To		360-WEP	362-HEX	
Phase		Vapor	Vapor	Solid
Mole Flows	kmol/hr	110	108	1.892
Volume Flow	l/min	54332	54334	0.657
Mass Flows	kg/hr	2676	2633	44
Temperature	°C	78	78	78
Pressure	kPag	-4.8	-4.8	
Enthalpy	kW	-3963	-3782	-181
Composition				
N2	kg/hr	1406	1406	1.56E-02
O2	kg/hr	122	122	1.57E-03
CO2	kg/hr	229	229	1.98E-02
H2O	kg/hr	907	875	3.19E+01
CO	kg/hr	3.84E-05	3.84E-05	4.48E-10
H2	kg/hr	2.76E-06	2.76E-06	3.04E-12
NO	kg/hr	3.27E-01	3.27E-01	1.31E-06
NO2	kg/hr			
SO2	kg/hr			
HF	kg/hr	1.65E-01	1.65E-01	4.43E-04
H3PO4	kg/hr	1.18E+01	5.32E-07	1.18E+01

APPENDICES

Appendix A. HSC Chemistry Data

Appendix B. CHEETAH Data

Appendix C. Munition Characterization Table

Appendix D. Simplified Block Flow Diagram

Appendix E. External Review and Responses

----- Stand-alone Appendices -----

Appendix F. SDC-1200 System

Appendix G. SDC-2000 System

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Appendix A. HSC Chemistry Data

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Case 1

<i>HSC Chemistry Inputs (Appendix A-Case 1)</i>		<i>HSC Chemistry Outputs (Appendix A-Case 1)</i>		
Compound/Breakdown	Kmol/hr	Temperature	kmol/hr	kg/hr
VX	5.14E-03	N2(g)	6.32E+00	1.77E+02
C	5.65E-02	O2(g)	1.18E+00	3.77E+01
H	1.34E-01	CO2(g)	4.59E-01	2.02E+01
N	5.14E-03	H2O(g)	3.97E-01	7.16E+00
O	1.03E-02	H2SO4	5.14E-03	5.04E-01
P	5.14E-03	H3PO4	3.05E-05	2.98E-03
S	5.14E-03	P4O10(g)	1.28E-03	3.63E-01
GB		NO(g)	1.73E-05	5.20E-04
C		P2O5	1.90E-05	2.69E-03
H		NO2(g)	4.19E-06	1.93E-04
F		H2(g)	6.64E-14	1.34E-13
O		CO(g)	2.11E-14	5.92E-13
P		NH3(g)	1.50E-23	2.55E-22
Air	8.00E+00			
N	1.26E+01			
O	3.36E+00			
Cellulose	6.71E-02			
C	4.03E-01			
H	6.71E-01			
O	3.36E-01			

Case 2

<i>HSC Chemistry Inputs (Appendix A-Case 2)</i>		<i>HSC Chemistry Outputs (Appendix A-Case 2)</i>		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX		N2(g)	7.37E+00	2.07E+02
C		CO2(g)	1.19E+00	5.22E+01
H		H2O(g)	1.02E+00	1.84E+01
N		O2(g)	7.05E-01	2.26E+01
O		HF(g)	2.77E-02	5.55E-01
P		P4O10(g)	6.95E-03	1.97E+00
S		POF3(g)	3.64E-05	3.78E-03
GB	2.78E-02	NO(g)	1.45E-05	4.34E-04
C	1.11E-01	NO2(g)	2.43E-06	1.12E-04
H	2.78E-01	H2(g)	2.68E-13	5.40E-13
F	2.78E-02	CO(g)	7.85E-14	2.20E-12
O	5.57E-02	NH3(g)	1.06E-22	1.80E-21
P	2.78E-02			
Air	9.33E+00			
N	1.47E+01			
O	3.92E+00			
Cellulose	1.79E-01			
C	1.07E+00			
H	1.79E+00			
O	8.95E-01			

Case 3

<i>HSC Chemistry Inputs (Appendix A-Case 3)</i>		<i>HSC Chemistry Outputs (Appendix A-Case 3)</i>		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX	1.37E-02	N2(g)	7.38E+00	2.07E+02
C	1.51E-01	CO2(g)	1.23E+00	5.39E+01
H	3.56E-01	H2O(g)	1.06E+00	1.91E+01
N	1.37E-02	O2(g)	6.22E-01	1.99E+01
O	2.74E-02	H2SO4	1.37E-02	1.34E+00
P	1.37E-02	H3PO4	3.21E-04	3.14E-02
S	1.37E-02	P4O10(g)	3.35E-03	9.50E-01
GB		P2O5	7.52E-05	1.07E-02
C		NO(g)	1.36E-05	4.08E-04
H		NO2(g)	2.16E-06	9.93E-05
F		H2(g)	2.70E-13	5.44E-13
O		CO(g)	8.59E-14	2.41E-12
P		NH3(g)	1.08E-22	1.84E-21
Air	9.33E+00			
N	1.47E+01			
O	3.92E+00			
Cellulose	1.79E-01			
C	1.07E+00			
H	1.79E+00			
O	8.95E-01			

Case 4

<i>HSC Chemistry Inputs (Appendix A-Case 4)</i>		<i>HSC Chemistry Outputs (Appendix A-Case 4)</i>		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX		N2(g)	6.32E+00	1.77E+02
C		O2(g)	1.21E+00	3.87E+01
H		CO2(g)	4.45E-01	1.96E+01
N		H2O(g)	3.83E-01	6.90E+00
O		HF(g)	1.04E-02	2.09E-01
P		P4O10(g)	2.61E-03	7.41E-01
S		POF3(g)	7.71E-06	8.01E-04
GB	1.05E-02	NO(g)	1.76E-05	5.27E-04
C	4.18E-02	NO2(g)	4.29E-06	1.97E-04
H	1.05E-01	H2(g)	6.91E-14	1.39E-13
F	1.05E-02	CO(g)	2.03E-14	5.67E-13
O	2.09E-02	NH3(g)	1.58E-23	2.69E-22
P	1.05E-02			
Air	8.00E+00			
N	1.26E+01			
O	3.36E+00			
Cellulose	6.71E-02			
C	4.03E-01			
H	6.71E-01			
O	3.36E-01			

Case 5

<i>HSC Chemistry Inputs (Appendix A-Case 5)</i>		<i>HSC Chemistry Outputs (Appendix A-Case 5)</i>		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX	4.07E-02	N2(g)	6.34E+00	1.78E+02
C	4.48E-01	CO2(g)	7.16E-01	3.15E+01
H	1.06E+00	O2(g)	6.28E-01	2.01E+01
N	4.07E-02	H2O(g)	7.12E-01	1.28E+01
O	8.14E-02	H2SO4	4.07E-02	3.99E+00
P	4.07E-02	H3PO4	5.78E-04	5.66E-02
S	4.07E-02	P4O10(g)	1.00E-02	2.85E+00
GB	0.00E+00	P2O5	4.29E-04	6.09E-02
C	0.00E+00	NO(g)	1.27E-05	3.80E-04
H	0.00E+00	NO2(g)	2.26E-06	1.04E-04
F	0.00E+00			
O	0.00E+00			
P	0.00E+00			
Air	8.00E+00			
N	1.26E+01			
O	3.36E+00			
Cellulose	4.48E-02			
C	2.69E-01			
H	4.48E-01			
O	2.24E-01			

Case 6

<i>HSC Chemistry Inputs (Appendix A-Case 6)</i>		<i>HSC Chemistry Outputs (Appendix A-Case 6)</i>		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX	6.11E-02	N2(g)	7.40E+00	2.07E+02
C	6.72E-01	CO2(g)	1.07E+00	4.73E+01
H	1.59E+00	H2O(g)	1.07E+00	1.92E+01
N	6.11E-02	O2(g)	3.82E-01	1.22E+01
O	1.22E-01	H2SO4	6.11E-02	5.99E+00
P	6.11E-02	H3PO4	1.34E-03	1.31E-01
S	6.11E-02	P4O10(g)	1.49E-02	4.24E+00
GB		P2O5	7.30E-04	1.04E-01
C		NO(g)	1.07E-05	3.20E-04
H		NO2(g)	1.37E-06	6.31E-05
F				
O				
P				
Air	9.33E+00			
N	1.47E+01			
O	3.92E+00			
Cellulose	6.71E-02			
C	4.03E-01			
H	6.71E-01			
O	3.36E-01			

Case 7

<i>HSC Chemistry Inputs (Appendix A-Case 7)</i>		<i>HSC Chemistry Outputs (Appendix A-Case 7)</i>		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX		N2(g)	7.37E+00	206.5652
C		O2(g)	1.81E+00	58.02662
H		H2O(g)	1.07E-01	1.920961
N		CO2(g)	1.03E-01	4.540931
O		HF(g)	1.67E-02	0.334705
P		P4O10(g)	4.29E-03	1.219247
S		POF3(g)	2.24E-04	0.023325
GB	1.74E-02	NO(g)	2.32E-05	0.000697
C	6.96E-02	NO2(g)	6.55E-06	0.000301
H	1.74E-01	H2(g)	1.67E-14	3.36E-14
F	1.74E-02	CO(g)	4.07E-15	1.14E-13
O	3.48E-02			
P	1.74E-02			
Air	9.33E+00			
N	1.47E+01			
O	3.92E+00			
Cellulose	5.60E-03			
C	3.36E-02			
H	5.60E-02			
O	2.80E-02			

Case 8

<i>HSC Chemistry Inputs (Appendix A-Case 8)</i>		<i>HSC Chemistry Outputs (Appendix A-Case 8)</i>		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX	8.57E-03	N2(g)	7.38E+00	2.07E+02
C	9.42E-02	O2(g)	1.76E+00	5.64E+01
H	2.23E-01	CO2(g)	1.28E-01	5.62E+00
N	8.57E-03	H2O(g)	1.31E-01	2.36E+00
O	1.71E-02	H2SO4	8.57E-03	8.40E-01
P	8.57E-03	P4O10(g)	2.14E-03	6.08E-01
S	8.57E-03	H3PO4	4.40E-06	4.31E-04
GB	0.00E+00	P2O5	3.84E-05	5.45E-03
C	0.00E+00	NO(g)	2.29E-05	6.87E-04
H	0.00E+00	NO2(g)	6.39E-06	2.94E-04
F	0.00E+00	P4O10	8.11E-08	2.30E-05
O	0.00E+00	H2O	2.65E-07	4.77E-06
P	0.00E+00	H2(g)	1.19E-14	2.39E-14
Air	9.33E+00	CO(g)	5.10E-15	1.43E-13
N	1.47E+01			
O	3.92E+00			
Cellulose	5.60E-03			
C	3.36E-02			
H	5.60E-02			
O	2.80E-02			

Case 9

HSC Chemistry Inputs (Appendix A-Case 9)		HSC Chemistry Outputs (Appendix A-Case 9)		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX				
C		N2(g)	7.37E+00	2.07E+02
H		O2(g)	1.67E+00	5.33E+01
N		H2O(g)	2.14E-01	3.85E+00
O		CO2(g)	2.06E-01	9.08E+00
P		HF(g)	3.27E-02	6.55E-01
S		P4O10(g)	8.53E-03	2.42E+00
GB	3.48E-02	POF3(g)	6.97E-04	7.25E-02
C	1.39E-01	NO(g)	2.23E-05	6.68E-04
H	3.48E-01	NO2(g)	5.99E-06	2.76E-04
F	3.48E-02	H2(g)	3.50E-14	7.06E-14
O	6.96E-02	CO(g)	8.53E-15	2.39E-13
P	3.48E-02			
Air	9.33E+00			
N	1.47E+01			
O	3.92E+00			
Cellulose	1.12E-02			
C	6.71E-02			
H	1.12E-01			
O	5.60E-02			

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Case 10

HSC Chemistry Inputs (Appendix A-Case 10)		HSC Chemistry Outputs (Appendix A-Case 10)		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX	6.11E-02	N2(g)	7.38E+00	2.07E+02
C	6.72E-01	O2(g)	1.56E+00	5.00E+01
H	1.59E+00	CO2(g)	2.56E-01	1.12E+01
N	6.11E-02	H2O(g)	2.62E-01	4.71E+00
O	1.22E-01	H2SO4*6.5H2O	1.71E-02	1.68E+00
P	6.11E-02	P4O10(g)	4.28E-03	1.21E+00
S	6.11E-02	H3PO4	2.96E-05	2.90E-03
GB		P2O5	1.09E-04	1.54E-02
C		NO(g)	2.16E-05	6.47E-04
H		NO2(g)	5.67E-06	2.61E-04
F		P4O10	3.24E-07	9.19E-05
O		H2O	1.06E-06	1.91E-05
P		H2(g)	2.52E-14	5.08E-14
Air	9.33E+00	CO(g)	1.08E-14	3.03E-13
N	1.47E+01			
O	3.92E+00			
Cellulose	6.71E-02			
C	4.03E-01			
H	6.71E-01			
O	3.36E-01			

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Case 11

HSC Chemistry Inputs (Appendix A-Case 11)		HSC Chemistry Outputs (Appendix A-Case 11)		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX	5.14E-02	N2(g)	6.35E+00	1.78E+02
C	5.65E-01	CO2(g)	7.67E-01	3.37E+01
H	1.34E+00	O2(g)	4.89E-01	1.56E+01
N	5.14E-02	H2O(g)	7.84E-01	1.41E+01
O	1.03E-01	H2SO4*6.5H2O	5.14E-02	5.04E+00
P	5.14E-02	H3PO4	7.94E-04	7.78E-02
S	5.14E-02	P4O10(g)	1.27E-02	3.59E+00
GB	0.00E+00	NO(g)	1.12E-05	3.36E-04
C	0.00E+00	H2O	1.13E-05	2.03E-04
H	0.00E+00	NO2(g)	1.77E-06	8.15E-05
F	0.00E+00	H3PO4*0.5H2O	3.70E-09	3.96E-07
O	0.00E+00	H2(g)	1.25E-13	2.53E-13
P	0.00E+00	CO(g)	5.39E-14	1.51E-12
Air	8.00E+00			
N	1.26E+01			
O	3.36E+00			
Cellulose	3.36E-02			
C	2.01E-01			
H	3.36E-01			
O	1.68E-01			

Case 12

<i>HSC Chemistry Inputs (Appendix A-Case 12)</i>		<i>HSC Chemistry Outputs (Appendix A-Case 12)</i>		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX	0.00E+00	N2(g)	7.37E+00	2.07E+02
C	0.00E+00	H2O(g)	6.39E-01	1.15E+01
H	0.00E+00	H2(g)	1.28E+00	2.59E+00
N	0.00E+00	CO2(g)	1.57E+00	6.90E+01
O	0.00E+00	CO(g)	4.01E-01	1.12E+01
P	0.00E+00	C	5.09E-01	6.11E+00
S	0.00E+00	HF(g)	4.18E-01	8.36E+00
GB	4.18E-01	P4O6(g)	1.04E-01	0.00E+00
C	1.67E+00	PH3	1.04E-01	3.55E+00
H	4.18E+00	H3PO4	3.13E-01	3.07E+01
F	4.18E-01	NH3(g)	9.22E-04	1.57E-02
O	8.35E-01	NO(g)	4.11E-18	1.23E-16
P	4.18E-01	O2(g)	5.69E-26	1.82E-24
Air	9.33E+00			
N	1.47E+01			
O	3.92E+00			
Cellulose	1.34E-01			
C	8.06E-01			
H	1.34E+00			
O	6.71E-01			

Case 13

<i>HSC Chemistry Inputs (Appendix A-Case 13)</i>		<i>HSC Chemistry Outputs (Appendix A-Case 13)</i>		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX	1.78E-01	N2(g)	7.46E+00	2.09E+02
C	1.96E+00	H2O(g)	1.59E+00	2.87E+01
H	4.63E+00	H2(g)	8.62E-01	1.74E+00
N	1.78E-01	CO2(g)	8.75E-01	3.85E+01
O	3.56E-01	C	1.51E+00	1.82E+01
P	1.78E-01	CO(g)	2.72E-01	7.61E+00
S	1.78E-01	H2SO4	1.78E-01	1.75E+01
GB	0.00E+00	H2S(g)	3.17E-20	1.08E-18
C	0.00E+00	P4O6(g)	4.46E-02	0.00E+00
H	0.00E+00	NH3(g)	6.20E-04	1.06E-02
F	0.00E+00	H2O	4.67E-05	0.00E+00
O	0.00E+00	PH3	4.46E-02	1.51E+00
P	0.00E+00	H3PO4	1.34E-01	1.31E+01
Air	9.33E+00	NO(g)	3.09E-18	9.27E-17
N	1.47E+01			
O	3.92E+00			
Cellulose	1.16E-01			
C	6.98E-01			
H	1.16E+00			
O	5.82E-01			

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Case 14

HSC Chemistry Inputs (Appendix A-Case 14)		HSC Chemistry Outputs (Appendix A-Case 14)		
Compound/Breakdown	kmol	Temperature	kmol/hr	kg/hr
VX	0.00E+00	N2(g)	6.32E+00	1.77E+02
C	0.00E+00	H2O(g)	1.05E+00	1.89E+01
H	0.00E+00	CO2(g)	1.24E+00	5.45E+01
N	0.00E+00	HF(g)	1.83E-01	3.65E+00
O	0.00E+00	P4O6(g)	4.02E-02	0.00E+00
P	0.00E+00	P4O10(g)	9.86E-03	2.80E+00
S	0.00E+00	H2(g)	4.47E-07	9.01E-07
GB	2.09E-01	CO(g)	1.08E-07	3.03E-06
C	8.35E-01	NO(g)	9.52E-12	2.86E-10
H	2.09E+00	O2(g)	3.56E-13	1.14E-11
F	2.09E-01			
O	4.18E-01			
P	2.09E-01			
Air	8.00E+00			
N	1.26E+01			
O	3.36E+00			
Cellulose	6.71E-02			
C	4.03E-01			
H	6.71E-01			
O	3.36E-01			

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Appendix B. CHEETAH Data

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

CHEETAH Simulation Data

Cases 1, 2, 3, 4, 11, 12, 13, and 14

Data for Case 1 through Case 4 and Case 11 through Case 14 can be found in the following PDF, included as an attachment:

All_Cases_MunitionEnergetics_Rev1.pdf. The data used in the Aspen simulation were taken from the case with a temperature of 784 Kelvin.

Cases 7, 8, 9, and 10

Data for Case 7, Case 8, Case 9, and Case 10 propellants can be found in the following PDF, included as an attachment:

Cases_7-10_PropellantEnergetics.pdf.

The data used in the Aspen simulation were taken from the case with a temperature of 820 Kelvin. Because the munitions in these cases contained the munitions simulated in **All_Cases_MunitionEnergetics_Rev1.pdf**, in addition to the propellants simulated in **Cases_7-10_PropellantEnergetics.pdf**, the results from **All_Cases_MunitionEnergetics_Rev1.pdf**

and

Cases_7-10_PropellantEnergetics.pdf

were combined as needed.

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Appendix C. Munition Characterization Table

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

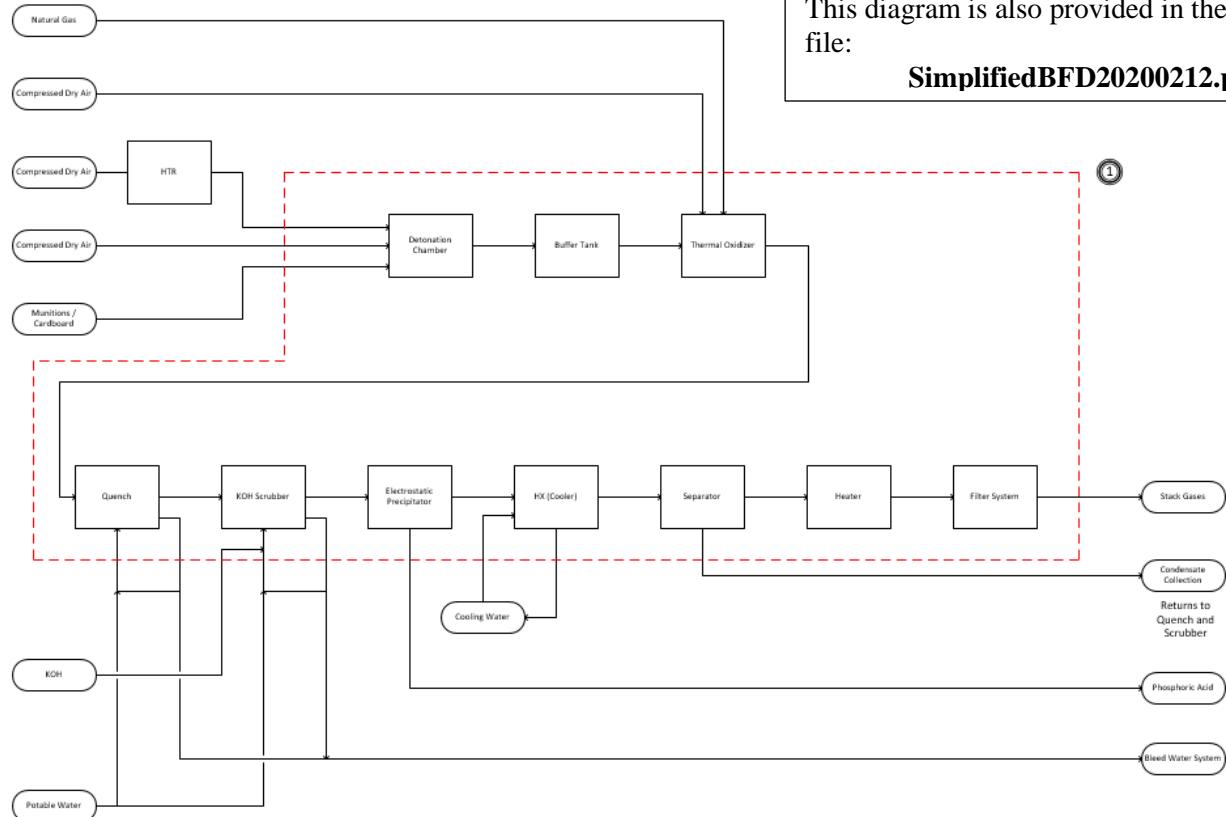
Munition Characterization Table (Appendix C)

Type	M56 WH	M56 WH	M56 WH	M56 WH	155MM PROJ	155MM PROJ	M55 RCKT	M55 RCKT	M55 RCKT	M55 RCKT	M56 WH	M56 WH	M56 WH	M56 WH
Fill	Drained	Drained	Drained	Drained	Undrained	Undrained	Undrained	Undrained	Undrained	Undrained	Undrained	Undrained	Undrained	Undrained
Case	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Agent	VX-1200	GB-2000	VX-2000	GB-1200	VX-D568-6lbs-1200	VX-D568-6lbs-2000	GB-2000	VX-2000	GB-2000	VX-2000	VX-1200	GB-2000	VX-2000	GB-1200
Pieces/Feed	2	4	4	2	2	2	1	1	1	1	1	4	4	2
Feed/hr	3	4	4	3	2	3	0.5	0.5	1	1	3	3	2.6	3
Burster (M34)	M34 Mix -2.5lbs	M34 Mix -2.5lbs	M34 Mix -2.5lbs	M34 Mix -2.5lbs	-	-	M34 Mix -2.5lbs	M34 Mix -2.5lbs	M34 Mix -2.5lbs	M34 Mix -2.5lbs	M34 Mix -2.5lbs	M34 Mix -2.5lbs	M34 Mix -2.5lbs	M34 Mix -2.5lbs
Burster 2 (M36)	M36 Com B-0.5lbs	M36 Com B-0.5lbs	M36 Com B-0.5lbs	M36 Com B-0.5lbs	-	-	M36 Com B-0.5lbs	M36 Com B-0.5lbs	M36 Com B-0.5lbs	M36 Com B-0.5lbs	M36 Com B-0.64lbs	M36 Com B-0.64lbs	M36 Com B-0.64lbs	M36 Com B-0.64lbs
Suppl Charg (TNT)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Fuze (M417)	M417-0.04lb	M417-0.04lb	M417-0.04lb	M417-0.04lb	-	-	M417-0.04lb	M417-0.04lb	M417-0.04lb	M417-0.04lb	M417-0.04lb	M417-0.04lb	M417-0.04lb	M417-0.04lb
Propellant (M28)	0.00	0.00	0.00	0.00	0.00	0.00	M28-19.3lb	M28-19.3lb	M28-19.3lb	M28-19.3lb	0.00	0.00	0.00	0.00
Primer (M62)	0.00	0.00	0.00	0.00	0.00	0.00	M62- 0.07lbs	M62- 0.07lbs	M62- 0.07lbs	M62- 0.07lbs	0.00	0.00	0.00	0.00
Packing density M34 (g/cm ³)	1.41	1.41	1.41	1.41	0.00	0.00	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41
Packing density M36 (g/cm ³)	1.38	1.38	1.38	1.38	0.00	0.00	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38
Cardboard box (cellulose) (lbs)	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4	4
Overpack material (SRC)	0.00	0.00	0.00	0.00	0.00	0.00	overpack (steel) 58lbs	overpack (steel) 58lbs	0.00	0.00	0.00	0.00	0.00	0.00
Other scrap (rckt shell-Al & steel)	-	-	-	-	-	-	24.69	24.69	24.69	24.69	-	-	-	-

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Appendix D. Simplified Block Flow Diagram

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION



Note 1: The red outline shows the simulation boundary line. Only the unit operations and process stream lines within the red outline have been modeled.

This diagram is also provided in the attached file:

SimplifiedBFD20200212.pdf

Simplified Block Flow Diagram (Appendix D)

Attached as PDF: **SimplifiedBFD20200212.pdf**

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Appendix E. External Review and Responses

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

COMMENTS AND SWRI/LEIDOS RESPONSES TO THE REVIEW

Items for Dynasafe are **in red**

SwRI responses are **in green**

Items for Leidos attention or action are **in orange**

Marianne Arensmeyer's replies **in purple**

SWRI M&EB Comments:

1. Has Dynasafe confirmed M&EBs match their design? [Comment for Dynasafe.] I will pass this on to Dynasafe
2. Do M&EBs reference same Dynasafe document revisions as in IW? Do M&EBs reference or supersede Dynasafe M&EBs? [The values in the report were derived from multiple sources. They were the most consistent and current values that could be identified. Unless Leidos determines that Dynasafe is using incorrect values, the report should have no effect on Dynasafe.] The M&Es were developed from the latest known information. If needed, M&Es will be revised after future design reviews. M&Es will not be performed by Dynasafe. This does not require any action from SwRI at this time. Will Dynasafe be resubmitting their M&EBs to match? [Comment for Dynasafe.]
3. Are M&EBs preliminary (based assumptions/emails/telecons/questions) or final (based on documents)? [At present, per acceptance of the report by Leidos, SwRI has no plans to update or change the report. SwRI will do so at Leidos' request] At this time, we will update report only so far as to add the other cases (below), correct the minor issues. If there are design changes, we will update the M&Es
4. Do M&EBs include CRG containerization materials? How do M&EBs account for VX projos not having bursters? [The cases in the report include trays where indicated and omit bursters where specified.] We did not see any value in adding the CRG containerization materials. They do not add any BTU and just basically become scrap. We will ask the question at the SDC 90% design review, but no action now.
5. Reference the Aspen PFD on Page 9 of the report. Note that liquid flow out of the quench is Stream 86. This stream goes to the Bleed Water Tank, and there is no provision for recycling.

[There was some discussion after SwRI sent the first set of preliminary simulation results about adding a recycle stream to the neutral scrubber (NSC), and it was added to the simulation. There was not a mention of adding a recycle stream to the quench vessel. If a recycle stream is needed, the simulation will have to be altered, and the Aspen stream tables will need to be regenerated. Leidos: Please advise.] As of the design today, there is no provision for recycle stream, no change needed.

On the M&EBs, Stream 86 is missing part of the time (e.g., Case 1), but it can be easily calculated from the other streams. To make this easy, go to Case 2 (page 23).

[This is a typo that was not corrected and can be fixed easily. Refer to Case 2 stream tables for correct stream assignments. Leidos: If only typos are identified, SwRI will correct them and provide the corrected report without declaring it a revision.] As stated above, there is no provision for recycle stream at this time.

Stream 86 is 8481 kg/Hr = 18,658 lb/hr. Assume a density of 8.1 lbs/gal, so the flow is 2,303 gal/hr = 38.3 gpm and 55,272 gallons per day, assuming that the TOX will be operating all the time (even if it is in a hot idle, the quench will be running).

[This relates to the absence of the recycle stream on the quench vessel in the simulation. The label "Stream 86" may not be the best choice, as Stream 86 is the portion of the liquid in the quench vessel sump that is pumped towards the bleed water tank (according to the Dynasafe

process flow diagram that was provided), and most of this liquid is likely recycled back to the top of the quench vessel, thus recycle streams do not affect the mass balance on the overall system. The portion of liquid sent to the bleed water tank is determined by a solenoid valve in line that alternates recycling liquid back to the quench vessel (Stream 85) and the bleed water tank (Stream 86). That being said, the flow rate back to the bleed water tank is said to be 0 kg/hr on the M&EB. If a recycle stream is wanted, then we will need to know a flow rate for the recycle, a flow rate for the stream headed to the bleed water tank, and a fresh water flow rate. Leidos: Please advise.] As of this time, no provision for a recycle stream

Case 4 is for the 1200, and the flow rate is higher than the one discussed above. [Perhaps Leidos can resolve this.]

[FYI: Case 1 and Case 4 are both for the SDC- 1200. They have Stream 86 flow rates of 8513 kg/hr and 8514 kg/hr respectively (close enough to be considered the same). When compared to cases for the SDC- 2000, such as Case 2 and Case 3, the flows for Stream 86 are smaller. This is likely due to the fact that Case 2 and Case 3 are producing larger quantities of high- temperature combustion products out of the thermal oxidizer (THO), which are sent to the quench vessel. More water will be evaporated when this 252 kg/hr of hot gas from the THO (Case 1) is sent to the quench vessel compared to 325 kg/hr (Case 2), resulting in a lower flow rate for Stream 86.] No action required.

Missing cases based on what ENV has been asked to permit (we won't be able to get a permit for treating these items without valid cases to submit to KDEP): [Perhaps Leidos can resolve this. Please advise.]

- GB projos (drained or undrained)
- M56 GB warhead undrained Please run this case for 1200 and 2000
- M56 VX warhead undrained Please run this case for 1200 and 2000
- leaker rockets with SFTs in place
- separated rocket motors with SFTs in place

Note that narrative states that current MEBs do not address PCBs/TSCA, but that this "may or may not be future work". [Perhaps Leidos can resolve this.]

6. The narrative in the report state that 2100°F (Section 4.5) was used in the TOX, but the

balances show 1800°F as the temperature used. Need resolution/clarification on which temperature was used for consistency

[This is a typo. We were instructed to change it to 1800 F, and that is the temperature that was used in the simulation. This just needs to be updated in the report.]

7. Recommend deletion of Section 3, which provides a timeline of MEB development. [The report body is the SwRI report to Leidos. SwRI understood that Appendices E and F (only) would be submitted for permitting. Section 3 tries to recount the difficulty of obtaining a consistent and current description of the hardware and conditions that are planned for applicability to the cases as defined for the calculation of the mass and energy balances. Perhaps Leidos can resolve this. You do not have to address this.]
8. Is Figure 1 complete? The only recycle stream listed is cooling water. Should a QUE liquid output slip stream be captured here?

[Figure 1 is not complete. This is the block flow diagram that was started in Anniston and explained as such in the text.] Do not add the Quench recycle.

9. Recommend confirming that Figure 2's block flow is most updated version.

[Figure 2 is not the most recent version. The most recent version is shown in Appendix D and was provided with the report as an additional PDF document. Figure 1 and Figure 2 were added because they pertained to the Anniston trip. Leidos: Are these confusing? Should they be removed?] Apparently, these are confusing. Please remove

Section 4.2 states that 'Stream names in the Aspen model reflect the stream names that were given to streams in the Dynasafe mass and energy balances provided to SwRI.' Recommend this be modified to "Stream names in the Aspen model reflect the stream names that were given to streams by Dynasafe." [Perhaps Leidos can resolve this.]

10. What is "Worst Case" for permitting purposes for both campaigns in both units? See discussion below to add clarity to the question:

The "worst case" will be mostly driven by the amount of agent being fed (especially since the OTS removal efficiencies are suspect). The agent has a much stronger influence on emissions than energetics. If the agent amounts were equal, then GB is worse than VX because the acids are worse. However, the GB cases that are here are not nearly as loaded up as the VX cases.

The worst case appears to be for the VX projos.

For the 1200, that is Case 5 where we are feeding 10.89 Kg per hour of VX. For the 2000, that is Case 6 where we are feeding 16.33 Kg per hour of VX.

It is possible the true worst case is a combination across cases...one would then use the worst for each emission from all the cases.

Please Confirm. [Perhaps Leidos can resolve this.] You do not have to address this.

FYI: These would likely be the cases that produce the most emissions. SwRI is unsure what the worst case would be for permitting purposes.

11. Feed inputs do not appear to include metals and other trace compounds and these are not propagated through the balances.

[Trace compounds from the combustibles were included to very low limits. Which exactly of the trace compounds are being referred to, and would this require a new simulation? Leidos: Please advise.] We will not be running a new simulation at this time.

12. Regulators are sensitive to cyanide; cyanide and a handful of other compounds are excluded in the Aspen model “because the largest concentration of any of these compounds is estimated to 106 parts per million (ppm).” Recommend stating the basis for 106 ppm in Section 4.2.[Additional tables can be added for each case showing the quantity of each material removed, or it can be put into the simulation (this would take additional time/labor). After some research, HCN should be able to be simulated up until the thermal oxidizer where it will thermally decompose into simple compounds that are already in the simulation. Leidos: Please advise.] What was your basis for 106 ppm?

13. Overpack materials masses should not have been included in Tables 43 and 48 for Cases 9 and 10

[This is a typo and can be fixed readily.]

14. Stream 60 and Stream “Filter” are both labeled as “400-IONEX”. These appear to be the same stream, just separated into different components. Recommend using something like “60” and “60B” for clarity, or combining those streams.

[The streams both have a source or “from” value of 400- IONEX. The “Filter” stream is meant to represent materials removed by the IONEX filtration system, because Aspen has to represent it as a stream. A note can be added to this effect, if desired.] Please add the note.

15. Because the assumption used for warhead drain is 95% drain efficiency, the estimated SDC agent throughput for some cases (like Case 1) is very low. For these low-agent-throughput cases, demonstration of DRE is a little harder from an analytical/technical perspective due to limitations of the stack monitors. We should negotiate the agent exhaust monitoring requirement and/or agent heel assumption with KDEP now. There are some options available:

(1) we can choose to demonstrate DRE on undrained munitions cases only (2) we can negotiate the manner in which the DRE would be demonstrated for drained munitions cases by assuming an estimated heel [we might be able to use measured masses, but keeping track of those and accuracy of the measurement could be issues], and (3) we should seek approval to use the monitoring limit of quantitation for DRE demonstration. Any one of these options would allow us to be successful, and we should pursue all of them. Main plant demonstration of DRE would not be put at risk from these options. [Perhaps Leidos can resolve this.] You do not have to address this.

16. Process note: If this system does generate significant liquid waste, demineralized process water may not be required as it is with the current mustard SDC process. It appears the process design is designed for waste minimization (in Figure 2), but that isn’t as clear in the MEB tables/cases. [Perhaps Leidos can resolve this.] Do nothing at this time.

17. Stream labels should be provided with Stream Numbers on the Case tables. All streams should be represented on the tables if they are discussed in the text. Recommend performing a stream label check on all stream numbers to make sure they are properly labeled (e.g., Figure 8 has an outlet stream with the label 54-NSCS, but Stream 54 is the WEP outlet in Figure 9; the lack of stream labels on the cases and mislabeled streams in the Figures makes it difficult to follow the process flow).

[This seems to be due to an additional unit op. being added to the main Aspen simulation as follows: The separator (labeled 360-WEP) was added to account for the pressure drop in the main Aspen simulation associated with the electrostatic precipitator. (This was requested in the review comments that Dynasafe had provided SwRI.) So, the WEP is represented in a separate simulation to prove its operation and in the main Aspen simulation because it is in the flow path. The separate simulation for the WEP is meant to demonstrate that it can effectively remove the phosphoric acid that it is meant to remove. Because outlet streams for separators must have a value, Stream 97 in the main simulation is set to remove 1% of the water and phosphorus-containing compounds to represent the loss of material that was not previously accounted for in the main Aspen simulation. If this is an issue, the simulation can be rerun. A better method would be to run the main simulation, get the inputs for the separate WEP simulation from Stream 53 (coming out of the scrubber), run the separate WEP simulation to prove that phosphoric acid is removed, and use the results from the separate WEP simulation to get the quantity of water that needs to be removed in the main simulation. As much of the manual actions such as this were avoided. Please advise if this change is preferred.] Just please do a label check that all of the streams are correctly labeled.

18. Recommend updating Figure 8 (NSC) to reflect liquid recirculation and liquid split (captured in the balances, but not described in the Section 4.7 text/figure).

[SwRI will add updated figure.]

19. Process note: The NSC will contain and recirculate a dilute potassium fluoride brine that is roughly 0.5 g/L potassium fluoride at 80°C. May want to ask Dynasafe to confirm MoC against that condition and determine if any special handling is required for handling KF salt creep and/or brine. Also, Dynasafe should ensure tight pH control of the NSC; the stated operating pH range of the scrubber is 6-7, which is just above the ambient HF pKa of 3.2. [Perhaps Leidos can resolve this.] This is for Dynasafe to answer.

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Appendix F. SDC-1200 System

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

SOUTHWEST RESEARCH INSTITUTE®
6220 CULEBRA ROAD • P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78228-0510

SDC-1200 System

Summary

Leidos Subcontract PO10234673
SwRI® Project 25967

Prepared by:

Nicholas Deom, BS
Tyler Maris, BS
Southwest Research Institute
Chemical Engineering Department

Prepared for:

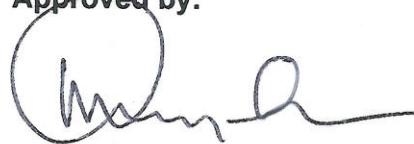
Leidos
Attn: James Ridgely
3465-A Box Hill Corporate Center Drive
Abingdon, MD 21040

Submitted by:



Nicholas Deom
Engineer
Fuels and Energy Development Section
Chemical Engineering Department

Approved by:



Michael G. MacNaughton, Ph.D., P.E.
Vice President
Chemistry and Chemical Engineering Div.

1. SUMMARY OF INCLUDED CASES SDC-1200 SYSTEM

Table 1. Table of Included Cases

Case	Description
1	SDC 1200 M56 VX WH Drained (5% heel)
4	SDC 1200 M56 GB WH Drained (5% heel)
5	SDC 1200 155mm VX Projo Undrained
11	SDC 1200 M56 VX WH Undrained
14	SDC 1200 M56 GB WH Undrained

2. SIMULATION ASSUMPTIONS

The following bulleted list provides a concise list of the assumptions used during the construction of the Aspen Plus model for the SDC 1200 system. The first list is a general set of assumptions that are true for the entire Aspen Plus model. The set of general assumptions is followed by several bulleted lists of assumptions that are categorized by unit operation. The titles for each section correspond to those below in *Figure 1. Aspen Model Process Flow Diagram* and *Figure 2. Electrostatic Precipitator*. Streams that leave the diagram are blank in the stream table on the TO line.

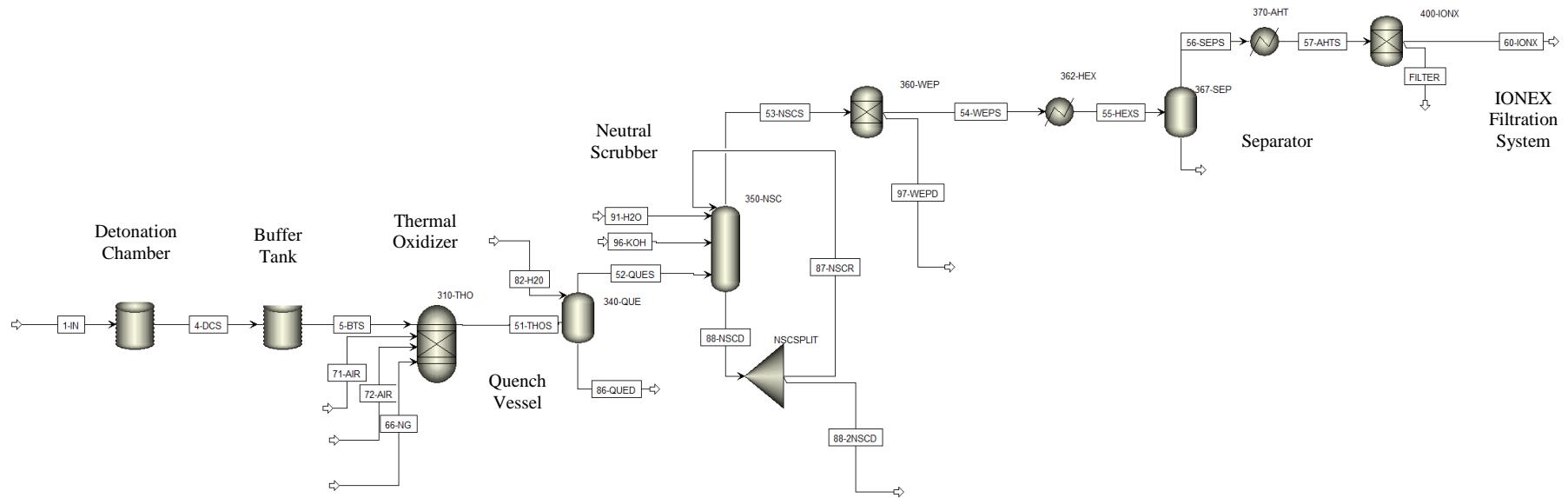


Figure 1. Aspen Model Process Flow Diagram

2.1 Global Assumptions

- Only unit operations which affect stack-gas composition or were in the direct flow path of the exhaust gases were included in the model.
- The model does not take into account heat losses that occur between unit operations if any.
- ELECNRTL was used as the global property method. Unit operations that didn't use the ELECNRTL property method used the NRTL property method.
- Outputs from CHEETAH and HSC Chemistry that did not appear in molar concentration above 1 part per billion (ppb) were removed to prevent potential chemical property method generation issues.
- The following compounds were removed from the Aspen Plus model, because Aspen's component library does not contain the information needed to generate property data, and experimental data could not be found: POF₃, CHNO, HCN, HNO₂, H₂F₂ (all compounds appeared in concentration less than or equal to 106 parts per million).

2.2 Detonation Chamber (120-DC)

- The detonation chamber was represented as a simple vessel and is used only as a visual representation of the detonation chamber.
- Within the Aspen Plus mode, the detonation chamber does not affect the temperature, pressure, or composition of the gas stream. In each case, those properties were either controlled by design or supplied from the combination of the CHEETAH and HSC Chemistry results.

2.3 Buffer Tank (160-BT)

- The buffer tank was modeled as a simple vessel in Aspen Plus, similar to the detonation chamber.
- Temperature: 550 °C
- Pressure: 29 kPag
- For the purpose of the simulation, the buffer tank does not affect the temperature, pressure, or composition of the gas stream, but the stream leaving the buffer tank includes the correct pressure, temperature, and composition.

2.4 Thermal Oxidizer (310-THO)

- The functional portion of the Aspen Plus model starts at the thermal oxidizer.
- The thermal oxidizer is modeled as a Gibbs Reactor.
- Temperature: 1150 °C
- Pressure: -1.0 kPag
- The efficiency of the burner package was not considered in the production of NO or NO₂.

2.5 Quench Vessel (340-QUE)

- The quench vessel was modeled as a flash drum.
- Temperature: 81 °C
- Pressure: -4.2 kPag
- The liquid and gas streams leave the quench vessel at the same temperature and pressure.
- The model assumes that no external heating or cooling occurs and that the only source of heat transfer is the water being pumped into the quench vessel at 9405 kg/hr and 80 °C.
- The liquid entrainment factor was assumed to be 1% by weight.

2.6 Neutral Scrubber (350-NSC)

- The neutral scrubber was modeled as a RadFrac column with four stages.
- Temperature: 81 °C
- Pressure: -4.8 kPag
- Between stages two and four, there is 15 mm Pall Ring packing with a height of 3000 mm.

2.7 Electrostatic Precipitator (360-WEP)

- The wet electrostatic precipitator (WEP) was modeled with 55 tubes, each with a diameter of 250 mm.
- The WEP was modeled in a separate simulation to ensure that it was capable of removing any phosphoric acid.
- The inlet to the precipitator (Stream 53) is a copy of Stream 54, exiting the neutral scrubber.

- Loading Area Voltage: 135 kV
- Precipitation Area Voltage: 78 kV
- The particle size assumed for the simulation was 0.99-1 μm

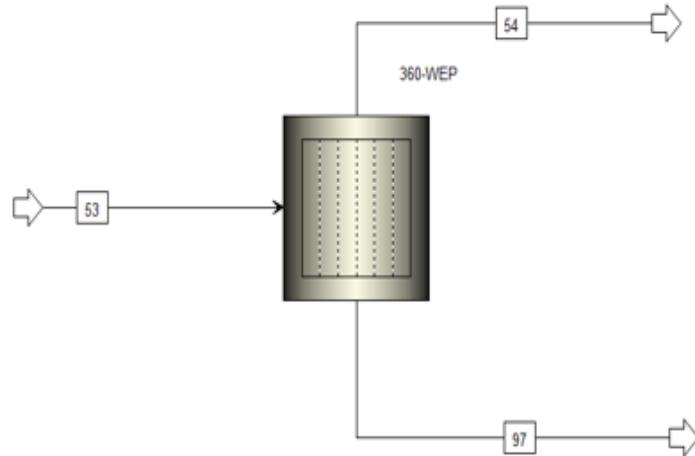


Figure 2. Electrostatic Precipitator

2.8 Heat Exchanger (362-HEX)

- The cooling media used in the heat exchanger was assumed to be an 80/20 wt% mixture of water and propylene glycol with a temperature of 10 °C.
- Heat Transfer Area: 95.9 m^3
- Fouling Factor: 0.85
- Hot-Side Inlet Temperature: 81 °C
- Hot-Side Outlet Temperature: 45 °C

2.9 Separator (367-SEP)

- The separator was modeled as a flash drum.
- The model assumed that no additional heating or cooling occurred within or outside of the separator.

2.10 Heater (370-AHT)

- The heater was modeled as a general heater block in Aspen Plus.
- Inlet Gas Temperature: 45 °C
- Outlet Gas Temperature: 60 °C
- It is assumed that the exchanger decreased relative humidity of the process gas to 50% or below, and it served no other purpose.

2.11 IONEX Filtration System (400-IXN)

- The IONEX filtration system was modeled as an Aspen separator, because Aspen Plus does not currently have unit operation blocks with the intended purpose of simulating gas-gas filtration.
- The model did not take particulate that was intended to be captured by the fiberglass and HEPA filters, in the IONEX filtration system, into consideration. It is for this reason that a single separator was used to model the activated carbon beds.
- The simulation does not take into account any NO_x, SO_x, or CO_x adsorption by the beds with the assumption than any adsorption would either be minimal, or the adsorption capacity of the activated carbon beds would be quickly used up.

3. RESULTS

Section 3 of this report contains the Aspen Plus simulation results for Case 1, Case 4, Case 5, Case 11, and Case 14. Each case has its own section. Type of munition, and feed rate of munitions are listed for each case on the case coversheet. Each case contains five tables: Munition Data, Feed Breakdown, Aspen Inputs, Stream Table, and Wet Electrostatic Precipitator Stream Table. The Munition Data table shows information about the munition in each case, most notably whether the munition is filled, what type of agent it contains, and the total number of munitions being simulated. The Feed Breakdown table shows a detailed list of components that make up the munition being considered and the mass flow rate of each component. The Aspen Inputs table shows a breakdown of the chemical compounds that were used as inputs in Aspen Plus. The Stream Table shows the simulation results for each stream that is represented in *Figure 1. Aspen Model Process Flow Diagram*. Finally, the Wet Electrostatic Precipitator Stream Table shows the simulation results for the WEP streams.

Case 1

Unit: SDC 1200
Munition: M56 VX Warhead Drained (5% Heel)
Feed Rate: 6 pieces/hr

Table 2. Munition Data (Case 1)

Per Case	M56 WH
Fill	Drained
Case	1
Agent	VX-1200
Pieces/Feed	2
Feed/hr	3
Total Pieces	6
Total Cardboard (lbs)	24

Table 3. Feed Breakdown (Case 1)

Part Name	lbs/piece	kg/piece	lbs/hr	kg/hr
Agent	0.505	0.23	3.03	1.37
Burster (M34)	2.5	1.13	15.00	6.80
Burster 2 (M36)	0.64	0.29	3.84	1.74
Suppl Charg (TNT)	0	0	0	0
Fuze (M417)	0.04	0.02	0.24	0.11
Propellant (M28)	0	0	0	0
Primer (M62)	0	0	0	0
Cardboard box (cellulose) (lbs)	4	1.81	24.00	10.89
Overpack material (SRC)	0	0	0	0
Other scrap (rckt shell-Al & steel)	-	-	-	-

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Table 4. Aspen Inputs (Case 1)

Component	kmol/hr
N2	6.41E+00
O2	1.18E+00
CO2	5.15E-01
H2O	4.39E-01
H2SO4	5.14E-03
H3PO4	3.05E-05
P4O10	1.28E-03
NO	1.73E-05
P2O5	1.90E-05
NO2	4.19E-06
H2	2.65E-02
CO	7.60E-02
NH3	2.37E-03
CH4	2.90E-02
C2H6	7.41E-04
C2H4	4.75E-04
CH3OH	4.07E-05
CH2O2	3.73E-05
C2H6O	1.13E-06
C3H8	2.07E-05
Benzene	1.63E-05
C2H2	1.13E-05
C (ash/soot)	1.66E-02

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Table 5. Stream Table (Case 1)

*Note: the "Filter Stream" represents the material collected by the IONEX filtration system (far right)

Table 6. Wet Electrostatic Precipitator Stream Table (Case 1)

Stream No.		53	54	97
From		350-NSC	360-WEP	360-WEP
To		360-WEP	362-HEX	
Phase		Vapor	Vapor	Solid
Mole Flows	kmol/hr	122	109	12.985
Volume Flow	l/min	54780	54779	4.030
Mass Flows	kg/hr	2880	2646	234.46
Temperature	°C	78	78	78
Pressure	kPag	-4.8	-4.8	
Enthalpy	kW	-4740	-3721	-1019
Composition				
N2	kg/hr	1406	1406	1.13E-01
O2	kg/hr	163	163	1.52E-02
CO2	kg/hr	194	194	1.22E-01
H2O	kg/hr	1116	882	2.34E+02
CO	kg/hr	2.83E-05	2.83E-05	2.40E-09
H2	kg/hr	2.22E-06	2.22E-06	1.77E-11
NO	kg/hr	3.77E-01	3.77E-01	1.10E-05
NO2	kg/hr	3.04E-03	3.00E-03	3.55E-05
SO2	kg/hr	4.36E-06	4.33E-06	2.81E-08
HF	kg/hr			
H3PO4	kg/hr	5.04E-01	2.78E-08	5.04E-01

Case 4

Unit: SDC 1200
Munition: M56 GB Warhead Drained (5% Heel)
Feed Rate: 6 pieces/hr

Table 7. Munition Data (Case 4)

Per Case	M56 WH
Fill	Drained
Case	4
Agent	GB
Pieces/Feed	2
Feed/hr	3
Total Pieces	6
Total Cardboard (lbs)	24

Table 8. Feed Breakdown (Case 4)

Part Name	lbs/piece	kg/piece	lbs/hr	kg/hr
Agent	0.538	0.24	3.23	1.46
Burster (M34)	2.5	1.13	15	6.80
Burster 2 (M36)	0.64	0.29	4	1.74
Suppl Charg (TNT)	0	0	0	0
Fuze (M417)	0.04	0.02	0.24	0.11
Propellant (M28)	0	0	0	0
Primer (M62)	0	0	0	0
Cardboard box (cellulose) (lbs)	4	1.81	24	10.89
Overpack material (SRC)	0	0	0	0
Other scrap (rckt shell-Al & steel)	-	-	-	-

Table 9. Aspen Inputs (Case 4)

Component	kmol/hr
N2(g)	6.41E+00
O2(g)	1.21E+00
CO2(g)	5.00E-01
H2O(g)	4.24E-01
HF(g)	1.04E-02
P4O10(g)	2.61E-03
NO(g)	1.76E-05
NO2(g)	4.29E-06
H2(g)	2.65E-02
CO(g)	7.60E-02
NH3(g)	2.37E-03
ch4	2.90E-02
c2h6	7.41E-04
c2h4	4.75E-04
ch3oh	4.07E-05
ch2o2	3.73E-05
c2h6o	1.13E-06
c3h8	2.07E-05
benzene	1.63E-05
c2h2	1.13E-05
C	1.66E-02

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Table 10. Stream Table (Case 4)

Stream No.	1	4	5	51	52	53	54	55	56	57	60	66	71	82	86	87	88	88-2	89	91	96	97	Filter *	
From		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400- IONX				340-QUE	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP		360-WEP	400- IONX		
To	120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400- IONX	(STACK)	310-THO	310-THO	340-QUE		350-NSC	NSCSPLIT		350-NSC	350-NSC		360-WEP		
Phase	Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Mixed	Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Filter									
Mole Flows	kmol/hr	8.71	8.71	8.71	67.9	117	117	116	116	66.5	66.4	3.80	55.4	522	473	816	824	7.3	49.9	6.4	0.52	0.57	0.07	
Volume Flow	l/min	9880	9880	9880	117693	58979	59131	59212	30715	30764	32325	32292	439	21587	161	146	252	254	2.2	15.1	1.9	0.135	0.177	0.0206
Mass Flows	kg/hr	252	252	252	1912	2803	2794	2784	2784	1884	1883	61	1599	9405	8514	14999	15134	134	900	116	10.4	10.32	1.22	
Temperature	C	550	550	550	982	80	80	45	45	60	60	20	20	80	80	80	80	45	20	20	80	60		
Pressure	kPag	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	4	1.0	4	1.0	1.0	1.0	1.0	4	3	1.0	0.9		
Enthalpy	kW	-47.6	-47.6	-47.6	-428	-4302	-4271	-4233	-4868	-921	-912	-908	-79.3	-2.2	-40874	-36999	-64293	-64876	-574	-3947	-512	-39.5	-44.8	-5.3
Composition																								
N2	kg/hr	180	180	180	1406	1406	1406	1406	1406	1406	1406	1406	1406	1227		0.0473	0.0740	0.0747	0.0007	0.0094				
O2	kg/hr	38.7	38.7	38.7	164	164	164	164	164	164	164	164	164	373		0.0094	0.0148	0.0149	0.0001	0.0021				
CO2	kg/hr	22.0	22.0	22.0	195	195	192	192	192	192	192	192	192		0.168	0.279	0.282	0.0025	0.0529					
H2O	kg/hr	7.65	7.65	7.65	146	1039	1032	1021	1021	122	122	122	120		9405	8512	14538	14668	130	900	116	7.28	10.32	1.22
H3O+	kg/hr	6.07E-12	6.07E-12	6.07E-12						4.52E-04					8.97E-05	2.94E-01	7.68E-07	7.70E-07	6.82E-09	4.52E-04	1.82E-07	1.03E-17	9.85E-08	7.12E-09
OH-	kg/hr	6.82E-17	6.82E-17	6.82E-17						2.33E-08					8.02E-05	2.23E-08	5.85E-02	5.94E-02	5.26E-04	2.33E-08	1.63E-07	9.46E-01	8.81E-08	6.37E-09
CO	kg/hr	2.13E+00	2.13E+00	2.13E+00	2.82E-05	2.81E-05	2.81E-05	2.81E-05	2.81E-05	2.81E-05	2.81E-05	2.81E-05	2.81E-05		7.11E-08	1.11E-07	1.12E-07	9.93E-10	2.52E-08					
CO3-	kg/hr	7.53E-29	7.53E-29	7.53E-29						3.53E-09					3.47E-12	2.71E+01	2.75E+01	2.44E-01	3.53E-09					
HCO3-	kg/hr	1.65E-15	1.65E-15	1.65E-15						1.45E-03					6.83E-05	1.72E+02	1.75E+02	1.55E+00	1.45E-03					
H2	kg/hr	5.34E-02	5.34E-02	5.34E-02	2.21E-06	2.21E-06	2.21E-06	2.21E-06	2.21E-06	2.21E-06	2.21E-06	2.21E-06	2.21E-06		1.16E-10	1.82E-10	1.84E-10	1.63E-12	2.06E-11					
NO	kg/hr	5.27E-04	5.27E-04	5.27E-04	3.78E-01	3.78E-01	3.78E-01	3.78E-01	3.78E-01	3.78E-01	3.78E-01	3.78E-01	3.78E-01		5.23E-05	8.13E-05	8.21E-05	7.27E-07	7.96E-05					
NO2	kg/hr	1.97E-04	1.97E-04	1.97E-04	4.11E-03	3.03E-03	3.01E-03	3.01E-03	3.01E-03	2.44E-03	2.44E-03	2.44E-03	2.44E-03		1.08E-03	1.69E-03	1.71E-03	1.51E-05	5.77E-04					
NH3	kg/hr	4.04E-02	4.04E-02	4.04E-02	2.99E-13					3.60E-06	3.60E-06	9.60E-07	9.52E-07	9.52E-07			1.05E-07	1.18E-07	1.04E-09	8.11E-09				
SO2	kg/hr									4.86E-09						3.73E+01	3.73E+01	3.31E-01	4.87E-09					
SO4-	kg/hr									3.33E-06						6.38E-01	6.11E-01	5.41E-03	3.33E-06					
SO3-	kg/hr																							
HSO3-	kg/hr																							
HSO4-	kg/hr																							
H2SO4	kg/hr																							
P4O10	kg/hr	7.41E-01	7.41E-01	7.41E-01											1.83E-14									
PO4---	kg/hr														2.55E-05									
HPO4--	kg/hr														6.95E-01									
H2PO4-	kg/hr														3.21E-01									
H3PO4	kg/hr									1.02E+00	1.75E-15													
C	kg/hr	1.99E-01	1.99E-01	1.99E-01	1.39E-14										6.10E+01									
CH4	kg/hr	4.65E-01	4.65E-01	4.65E-01																				
C2H2	kg/hr	2.93E-04	2.93E-04	2.93E-04																				
C2H4	kg/hr	1.33E-02	1.33E-02	1.33E-02																				
C2H6	kg/hr	2.23E-02	2.23E-02	2.23E-02																				
CH2O2	kg/hr	1.72E-03	1.72E-03	1.72E-03																				

Table 11. Wet Electrostatic Precipitator Stream Table (Case 4)

Stream No.		53	54	97
From		350-NSC	360-WEP	360-WEP
To		360-WEP	362-HEX	
Phase		Vapor	Vapor	Solid
Mole Flows	kmol/hr	117	109	8.222
Volume Flow	l/min	54769	54769	2.556
Mass Flows	kg/hr	2794	2645	149.03
Temperature	°C	78	78	78
Pressure	kPag	-4.8	-4.8	
Enthalpy	kW	-4363	-3716	-647
Composition				
N2	kg/hr	1406	1406	7.16E-02
O2	kg/hr	164	164	9.68E-03
CO2	kg/hr	192	192	7.66E-02
H2O	kg/hr	1030	882	1.48E+02
CO	kg/hr	2.81E-05	2.81E-05	1.51E-09
H2	kg/hr	2.21E-06	2.21E-06	1.12E-11
NO	kg/hr	3.78E-01	3.78E-01	6.96E-06
NO2	kg/hr	3.01E-03	2.99E-03	2.24E-05
SO2	kg/hr	3.60E-06	3.59E-06	1.47E-08
HF	kg/hr	1.20E-07	1.19E-07	1.47E-09
H3PO4	kg/hr	1.02E+00	5.63E-08	1.02E+00

Case 5

Unit: SDC 1200
Munition: 155mm VX Projectile Undrained
Feed Rate: 4 pieces/hr

Table 12. Munition Data (Case 5)

Per Case	M56 WH
Fill	Undrained
Case	5
Agent	VX
Pieces/Feed	2
Feed/hr	2
Total Pieces	4
Total Cardboard (lbs)	16

Table 13. Feed Breakdown (Case 5)

Part Name	lbs/piece	kg/piece	lbs/hr	kg/hr
Agent	6	2.72	24.00	10.89
Burster (M34)	-	-	-	-
Burster 2 (M36)	-	-	-	-
Suppl Charg (TNT)	0	0	0	0
Fuze (M417)	-	-	-	-
Propellant (M28)	0	0	0	0
Primer (M62)	0	0	0	0
Cardboard box (cellulose) (lbs)	4	1.81	16	7.26
Overpack material (SRC)	0	0	0	0
Other scrap (rckt shell-Al & steel)	-	-	-	-

Table 14. Aspen Inputs (Case 5)

Component	kmol/hr
N2	6.34E+00
CO2	7.16E-01
O2	6.28E-01
H2O	4.47E-01
H2SO4	4.07E-02
H3PO4	5.78E-04
P4O10	9.82E-03
P2O5	4.29E-04
NO	1.27E-05
NO2	2.26E-06

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Table 15. Stream Table (Case 5)

Stream No.	1	4	5	51	52	53	54	55	56	57	60	66	71	82	86	87	88	88-2	89	91	96	97	Filter *	
From		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400- 400- IONX			340-QUE	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP			360-WEP	400- IONX		
To		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	IONX	(STACK)	310-THO	310-THO	340-QUE	350-NSC	NSCSPLIT		350-NSC	350-NSC				
Phase	Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Mixed	Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Filter									
Mole Flows	kmol/hr	8.45	8.45	8.45	67.7	117	116	116	116	66.0	66.0	3.80	55.4	522	473	812	819	7.6	49.8	6.4	0.52	0.57	0.07	
Volume Flow	l/min	9592	9592	9592	117421	58869	58882	58962	30530	30578	32129	32097	439	21587	161	146	252	254	2.4	15.1	1.9	0.135	0.177	0.0205
Mass Flows	kg/hr	249	249	249	1909	2796	2782	2772	2772	1874	1874	1873	61	1599	9405	8518	15000	15141	141	898	116	10.4	10.29	1.21
Temperature	C	550	550	550	982	80	80	80	45	45	60	60	20	20	80	80	80	80	45	20	20	80	60	
Pressure	kPag	-1.0	-1.0	-1.0	-4.2	-4.8	-5.4	-6.0	-6.2	-6.5	-6.5	-250	3.0	260	-4.2	-4.8	-4.8	-4.8	-6.2	260	150	-4.8	-6.5	
Enthalpy	kW	-95.8	-95.8	-464	-4323	-4277	-4239	-4872	-934	-925	-921	-79.3	-2.2	-40874	-37014	-63890	-64488	-599	-3939	-512	-39.5	-44.7	-5.3	
Composition																								
N2	kg/hr	178	178	178	1404	1404	1404	1404	1404	1404	1404	1404	1227		0.0474	0.0727	0.0733	0.0007	0.0095					
O2	kg/hr	20.1	20.1	20.1	150	150	150	150	150	150	150	150	373		0.0087	0.0133	0.0134	0.0001	0.0019					
CO2	kg/hr	31.5	31.5	31.5	199	199	199	199	199	199	199	199			0.172	0.283	0.285	0.0026	0.0548					
H2O	kg/hr	12.8	12.8	12.8	149	1041	1029	1019	1019	121	121	120			9405	8513	14442	14577	135	898	116	7.28	10.29	1.21
H3O+	kg/hr	8.90E-10	8.90E-10	8.90E-10					3.52E-03					8.97E-05	4.74E-01	4.61E-05	4.74E-05	4.41E-07	3.52E-03	1.82E-07	1.03E-17	9.84E-08	7.08E-09	
OH-	kg/hr	9.78E-20	9.78E-20	9.78E-20					3.04E-09					8.02E-05	1.43E-08	1.07E-03	1.06E-03	9.84E-06	3.04E-09	1.63E-07	9.46E-01	8.79E-08	6.33E-09	
CO	kg/hr																							
CO3--	kg/hr	2.94E-34	2.94E-34	2.94E-34						6.41E-11						1.47E-12	1.08E-02	1.05E-02	9.71E-05	6.40E-11				
HCO3-	kg/hr	3.50E-18	3.50E-18	3.50E-18						1.96E-04						4.44E-05	3.24E+00	3.20E+00	2.97E-02	1.96E-04				
H2	kg/hr																							
NO	kg/hr	3.80E-04	3.80E-04	3.80E-04	3.62E-01	3.62E-01			4.98E-05	7.60E-05	7.67E-05	7.12E-07	7.64E-05											
NO2	kg/hr	1.04E-04	1.04E-04	1.04E-04	3.77E-03	2.78E-03	2.76E-03	2.76E-03	2.76E-03	2.23E-03	2.23E-03	2.23E-03			9.91E-04	1.52E-03	1.53E-03	1.42E-05	5.31E-04					
NH3	kg/hr																							
SO2	kg/hr									2.61E+00	2.48E+00	4.40E-02	4.40E-02	3.23E-02	3.21E-02	3.21E-02			5.05E-02	1.48E-03	1.54E-03	1.43E-05	2.75E-04	
SO4--	kg/hr	5.80E-22	5.80E-22	5.80E-22						2.88E-06						2.82E-06								
SO3--	kg/hr									1.47E-02						1.12E-06	1.79E+02	1.80E+02	1.67E+00	2.88E-06				
HSO3-	kg/hr															1.01E-01	1.46E+02	1.47E+02	1.37E+00	1.47E-02				
HSO4-	kg/hr	4.54E-09	4.54E-09	4.54E-09												3.84E-06								
H2SO4	kg/hr	3.99E+00	3.99E+00	3.99E+00	6.76E-06	3.33E-21										1.68E-15								
P4O10	kg/hr	2.85E+00	2.85E+00	2.85E+00																				
PO4---	kg/hr	2.18E-48	2.18E-48	2.18E-48												2.66E-14								
HPO4--	kg/hr	2.16E-30	2.16E-30	2.16E-30												5.50E-05								
H2PO4-	kg/hr	6.41E-15	6.41E-15	6.41E-15												2.29E+00								
H3PO4	kg/hr	5.66E-02	5.66E-02	5.66E-02	3.99E+00	9.10E-15										1.67E+00								
C	kg/hr																							
CH4	kg/hr																							
C2H2	kg/hr																							
C2H4	kg/hr																							
C2H6	kg/hr																							
CH2O2	kg/hr																							
C2H5OH	kg/hr																							
C3H8	kg/hr																							
CH3OH	kg/hr																							
ACETONE	kg/hr		</td																					

Table 16. Wet Electrostatic Precipitator Stream Table (Case 5)

Stream No.		53	54	97
From		350-NSC	360-WEP	360-WEP
To		360-WEP	362-HEX	
Phase		Vapor	Vapor	Solid
Mole Flows	kmol/hr	117	108	8.206
Volume Flow	l/min	54596	54596	2.569
Mass Flows	kg/hr	2786	2635	151.17
Temperature	°C	78	78	78
Pressure	kPag	-4.8	-4.8	
Enthalpy	kW	-4385	-3731	-654
Composition				
N2	kg/hr	1404	1404	7.13E-02
O2	kg/hr	150	150	8.84E-03
CO2	kg/hr	199	199	7.88E-02
H2O	kg/hr	1029	882	1.47E+02
CO	kg/hr			
H2	kg/hr			
NO	kg/hr	3.62E-01	3.62E-01	6.63E-06
NO2	kg/hr	2.76E-03	2.74E-03	2.04E-05
SO2	kg/hr	4.40E-02	4.38E-02	1.79E-04
HF	kg/hr			
H3PO4	kg/hr	3.99E+00	2.03E-07	3.99E+00

Case 11

**Unit: SDC 1200
Munition: M56 VX WH Undrained
Feed Rate: 3 pieces/hr**

Table 17. Munition Data (Case 11)

Per Case	M56 WH
Fill	Undrained
Case	11
Agent	VX-1200
Pieces/Feed	1
Feed/hr	3
Total Pieces	3
Total Cardboard (lbs)	12

Table 18. Feed Breakdown (Case 11)

Part Name	Ibs/piece	kg/piece	Ibs/hr	kg/hr
Agent	10.1	4.58	30.30	13.74
Burster (M34)	2.5	1.13	7.50	3.40
Burster 2 (M36)	0.64	0.29	1.92	0.87
Suppl Charg (TNT)	0	0	0	0
Fuze (M417)	0.040	0.018	0.12	0.05
Propellant (M28)	0	0	0.00	0.00
Primer (M62)	0.000	0.000	0.000	0.000
Cardboard box (cellulose) (lbs)	4	1.81	12.00	5.44
Overpack material (SRC)	0	0	0.00	0.00
Other scrap (rckt shell-Al & steel)	0	0	0.00	0.00

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Table 19. Aspen Inputs (Case 11)

Component	kmol/hr
N2	6.39E+00
O2	4.89E-01
CO2	7.95E-01
H2O	8.04E-01
CO	3.80E-02
H2	1.32E-02
NO	1.12E-05
NO2	1.77E-06
NH3	1.19E-03
H2SO4	5.14E-02
P4O10	1.27E-02
H3PO4	7.94E-04
HCN	7.80E-06
C	8.28E-03
CH4	1.45E-02
C2H2	5.63E-06
C2H4	2.37E-04
C2H6	3.70E-04
CH2O2	1.87E-05
C2H5OH	5.67E-07
C3H8	1.04E-05
CH3OH	2.04E-05
ACETONE	2.37E-07
BENZENE	8.17E-06

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Table 20. Stream Table (Case 11)

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Stream No.	1	4	5	51	52	53	54	55	56	57	60	66	71	72	82	86	87	88	88-2	89	91	96	97	Filter *	
From		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX				340-QUE	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP			360-WEP	400-IONX		
To	120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX		310-THO	310-THO	310-THO	340-QUE	350-NSC	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP	350-NSC	350-NSC			
HF	kg/hr																								
F-	kg/hr																								
HCL	kg/hr																								
CL-	kg/hr																								
KCL	kg/hr																								
KOH	kg/hr																								
K+	kg/hr																								
K	kg/hr																								
MGO	kg/hr																								
MG	kg/hr																								
NH4+	kg/hr	8.64E-11	8.64E-11	8.64E-11																					
HCOO-	kg/hr	1.95E-14	1.95E-14	1.95E-14																					
NH2COO-	kg/hr	1.86E-22	1.86E-22	1.86E-22																					
CN-	kg/hr	7.73E-24	7.73E-24	7.73E-24																					

*Note: the "Filter Stream" represents the material collected by the IONEX filtration system (far right)

Table 21. Wet Electrostatic Precipitator Stream Table (Case 11)

Stream No.		53	54	97
From		350-NSC	360-WEP	360-WEP
To		360-WEP	362-HEX	
Phase		Vapor	Vapor	Solid
Mole Flows	kmol/hr	109	108	0.446
Volume Flow	l/min	54553	54556	0.168
Mass Flows	kg/hr	2647	2635	12
Temperature	°C	78	78	78
Pressure	kPag	-4.8	-4.8	
Enthalpy	kW	-3791	-3742	-49
Composition				
N2	kg/hr	1406	1406	3.45E-03
O2	kg/hr	144	144	4.10E-04
CO2	kg/hr	205	205	3.93E-03
H2O	kg/hr	888	881	7.11E+00
CO	kg/hr	3.16E-05	3.16E-05	8.18E-11
H2	kg/hr	2.45E-06	2.45E-06	5.98E-13
NO	kg/hr	3.54E-01	3.54E-01	3.14E-07
NO2	kg/hr	2.47E-03	2.47E-03	8.91E-07
SO2	kg/hr	1.79E-02	1.79E-02	3.54E-06
HF	kg/hr			
H3PO4	kg/hr	5.04E+00	2.52E-07	5.04E+00

Case 14

Unit: SDC 1200
Munition: M56 GB WH Undrained
Feed Rate: 6 pieces/hr

Table 22. Munition Data (Case 14)

Per Case	M56 WH
Fill	Undrained
Case	14
Agent	GB-1200
Pieces/Feed	2
Feed/hr	3
Total Pieces	6
Total Cardboard (lbs)	24

Table 23. Feed Breakdown (Case 14)

Part Name	lbs/piece	kg/piece	lbs/hr	kg/hr
Agent	10.75	4.88	64.50	29.26
Burster (M34)	2.5	1.13	15.00	6.80
Burster 2 (M36)	0.64	0.29	3.84	1.74
Suppl Charg (TNT)	0	0	0	0
Fuze (M417)	0.040	0.018	0.24	0.11
Propellant (M28)	0	0	0.00	0.00
Primer (M62)	0.000	0.000	0.000	0.000
Cardboard box (cellulose) (lbs)	4	1.81	24.00	10.89
Overpack material (SRC)	0	0	0.00	0.00
Other scrap (rckt shell-Al & steel)	0	0	0.00	0.00

Table 24. Aspen Inputs (Case 14)

Component	kmol/hr
N2	6.41E+00
O2	4.21E-13
CO2	1.29E+00
H2O	1.09E+00
CO	7.60E-02
H2	2.65E-02
NO	1.44E-09
NO2	3.41E-16
NH3	2.37E-03
P4O10	9.86E-03
PH3	4.02E-02
H3PO4	1.20E-01
HCN	1.56E-05
C	1.66E-02
CH4	2.90E-02
C2H2	1.13E-05
C2H4	4.75E-04
C2H6	7.41E-04
CH2O2	3.73E-05
C2H5OH	1.13E-06
C3H8	2.07E-05
CH3OH	4.07E-05
ACETONE	4.75E-07
BENZENE	1.63E-05
HF	1.83E-01

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Table 25. Stream Table (Case 14)

Stream No.	1	4	5	51	52	53	54	55	56	57	60	66	71	82	86	87	88	88-2	89	91	96	97	Filter *			
From		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX			340-QUE	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP			360-WEP	400-IONX				
To		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	(STACK)	310-THO	310-THO	340-QUE	350-NSC	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP		350-NSC	350-NSC				
Phase	Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Mixed	Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Filter											
Mole Flows	kmol/hr	9.29	9.29	9.29	68.4	118	110	109	65.9	65.9	65.9	3.80	55.4	522.1	472.0	832.0	924.6	92.6	43.2	83.3	0.5	0.5	0.1			
Volume Flow	l/min	10349	10349	10349	118530	59567	55143	55235	30478	30528	32045	439	21587	161	146	257	285	29	13	25	0	0	0			
Mass Flows	kg/hr	278	278	278	1939	2825	2666	2657	2657	1879	1878	61	1599	9405	8519	15000	16670	1670	778	1500	10	9	1			
Temperature	C	550	550	550	982	80	78	45	45	60	60	20	20	80	80	80	80	80	45	20	20	78	60			
Pressure	kPag	-1.0	-1.0	-1.0	-4.2	-4.8	-5.4	-6.0	-6.2	-6.5	-6.5	250	3.0	260.0	-4.2	-4.8	-4.8	-4.8	-6.2	260.0	150.0	-4.8	-6.5			
Enthalpy	kW	-222.2	-222.2	-222.2	-623	-4492	-3905	-3871	-4420	-1009	-1001	-996	-79.3	-2.2	-40873.8	-37005.0	-65139.5	-72389.6	-7250.1	-3411.3	-6623.5	-39.5	-39.4	-5.3		
Composition																										
N2	kg/hr	180	180	180	1406	1406	1406	1406	1406	1406	1406	1227		0.047	0.081	0.090	0.009	0.008								
O2	kg/hr				122	122	122	122	122	122	122	373		0.007	0.012	0.013	0.0014	0.0013								
CO2	kg/hr	56.8	56.8	56.8	229	229	229	229	229	229	229		0.20	0.34	0.38	0.04	0.05									
H2O	kg/hr	19.64	19.64	19.64	157	1065	907	898	898	121	121	119		9405	8495	14969	16635	1666	777	1500	7.28	9.07	1.21			
H3O+	kg/hr	1.19E-11	1.19E-11	1.19E-11				1.11E-01					8.97E-05	2.26E+00	5.66E-01	6.29E-01	6.30E-02	1.11E-01	2.35E-06	1.03E-17	8.33E-08	7.06E-09				
OH-	kg/hr	3.98E-17	3.98E-17	3.98E-17				8.53E-11					8.02E-05	3.52E-09	5.00E-08	5.55E-08	5.56E-09	8.51E-11	2.10E-06	9.46E-01	7.45E-08	6.32E-09				
CO	kg/hr	2.13E+00	2.13E+00	2.13E+00	3.85E-05	3.84E-05	3.84E-05	3.84E-05	3.84E-05	3.84E-05	3.84E-05		9.54E-08	1.67E-07	1.85E-07	1.85E-08	3.00E-08									
CO3--	kg/hr	2.87E-30	2.87E-30	2.87E-30				7.85E-14					1.14E-13	1.50E-11	1.66E-11	1.67E-12	7.83E-14									
HCO3-	kg/hr	6.19E-14	6.19E-14	6.19E-14				6.36E-06					1.23E-05	1.75E-04	1.95E-04	1.95E-05	6.35E-06									
H2CO3	kg/hr																									
H2	kg/hr	5.34E-02	5.34E-02	5.34E-02	2.76E-06		1.44E-10	2.50E-10	2.78E-10	2.78E-11	2.24E-11															
NO	kg/hr	4.32E-08	4.32E-08	4.32E-08	3.27E-01		4.35E-05	7.67E-05	8.52E-05	8.53E-06	5.99E-05															
NO2	kg/hr																									
NH3	kg/hr	4.04E-02	4.04E-02	4.04E-02	4.15E-13																					
H2S	kg/hr																									
SO2	kg/hr																									
SO4--	kg/hr																									
SO3--	kg/hr																									
HSO3-	kg/hr																									
HSO4-	kg/hr																									
H2SO4	kg/hr																									
K2SO3	kg/hr																									
K2SO4	kg/hr																									
P4O10	kg/hr	2.80E+00	2.80E+00	2.80E+00																						
P4O6	kg/hr																									
PH3	kg/hr	1.37E+00	1.37E+00	1.37E+00	4.47E-26								5.05E-15													
PO4---	kg/hr	4.27E-41	4.27E-41	4.27E-41									3.25E-05													
HPO4--	kg/hr	1.51E-21	1.51E-21	1.51E-21																						
H2PO4-	kg/hr	3.39E-06	3.39E-06	3.39E-06									4.87E+00													
H3PO4	kg/hr	1.18E+01	1.18E+01	1.18E+01	1.96E+01	8.09E-14							1.46E+01													
K2HPO4	kg/hr																									
HCN	kg/hr	4.22E-04	4.22E-04	4.22E-04	2.06E-21																					
C	kg/hr	1.99E-01	1.99E-01	1.99E-01	2.21E-14								6.10E+01													
CH4	kg/hr	4.65E-01	4.65E-01	4																						

COMMERCIAL CONFIDENTIAL AND PROPRIETARY INFORMATION

Stream No.	1	4	5	51	52	53	54	55	56	57	60	66	71	82	86	87	88	88-2	89	91	96	97	Filter *	
From		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX				340-QUE	NSCSPLIT	350-NSC	NSCSPLIT	367-SEP		360-WEP	400-IONX		
To		120-DC	160-BT	310-THO	340-QUE	350-NSC	360-WEP	362-HEX	367-SEP	370-AHT	400-IONX				310-THO	310-THO	340-QUE		350-NSC	350-NSC				
F-	kg/hr	2.27E-13	2.27E-13	2.27E-13																				
HCL	kg/hr																							
CL-	kg/hr																							
KCL	kg/hr																							
KOH	kg/hr																							
K+	kg/hr																							
K	kg/hr																							
MGO	kg/hr																							
MG	kg/hr																							
NH4+	kg/hr	6.31E-07	6.31E-07	6.31E-07																				
HCOO-	kg/hr	1.34E-11	1.34E-11	1.34E-11																				
NH2COO-	kg/hr	3.20E-19	3.20E-19	3.20E-19																				
CN-	kg/hr	5.29E-21	5.29E-21	5.29E-21																				
HS-	kg/hr																							
S--	kg/hr																							

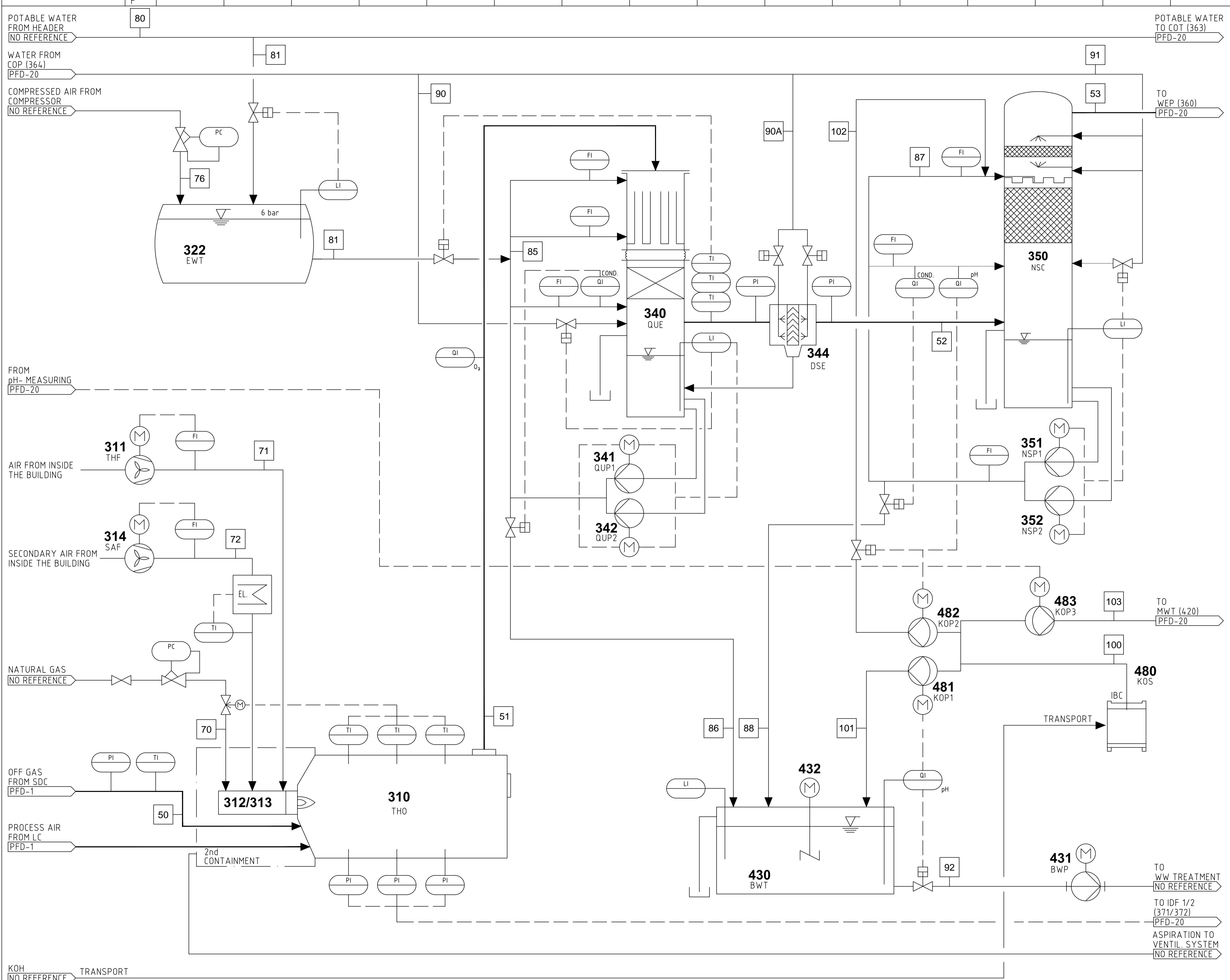
*Note: the "Filter Stream" represents the material collected by the IONEX filtration system (far right)

Table 26. Wet Electrostatic Precipitator Stream Table (Case 14)

Stream No.		53	54	97
From		350-NSC	360-WEP	360-WEP
To		360-WEP	362-HEX	
Phase		Vapor	Vapor	Solid
Mole Flows	kmol/hr	110	108	1.892
Volume Flow	l/min	54332	54334	0.657
Mass Flows	kg/hr	2676	2633	44
Temperature	°C	78	78	78
Pressure	kPag	-4.8	-4.8	
Enthalpy	kW	-3963	-3782	-181
Composition				
N2	kg/hr	1406	1406	1.56E-02
O2	kg/hr	122	122	1.57E-03
CO2	kg/hr	229	229	1.98E-02
H2O	kg/hr	907	875	3.19E+01
CO	kg/hr	3.84E-05	3.84E-05	4.48E-10
H2	kg/hr	2.76E-06	2.76E-06	3.04E-12
NO	kg/hr	3.27E-01	3.27E-01	1.31E-06
NO2	kg/hr			
SO2	kg/hr			
HF	kg/hr	1.65E-01	1.65E-01	4.43E-04
H3PO4	kg/hr	1.18E+01	5.32E-07	1.18E+01

STREAM NO.	...								
MEDIUM	...								
AMOUNT	kg/h lbs/h gal/min Nm ³ /h scfm								
PRESSURE	mbar psi								
TEMPERATURE	°C °F								

STREAM TABLE DRAWN SEPARATELY FOR CLARITY PURPOSE, REFER TO MASS BALANCE



NOTES: ALL DESIGN HAS BEEN DONE BASED ON SI-UNITS

COMPONENTS:

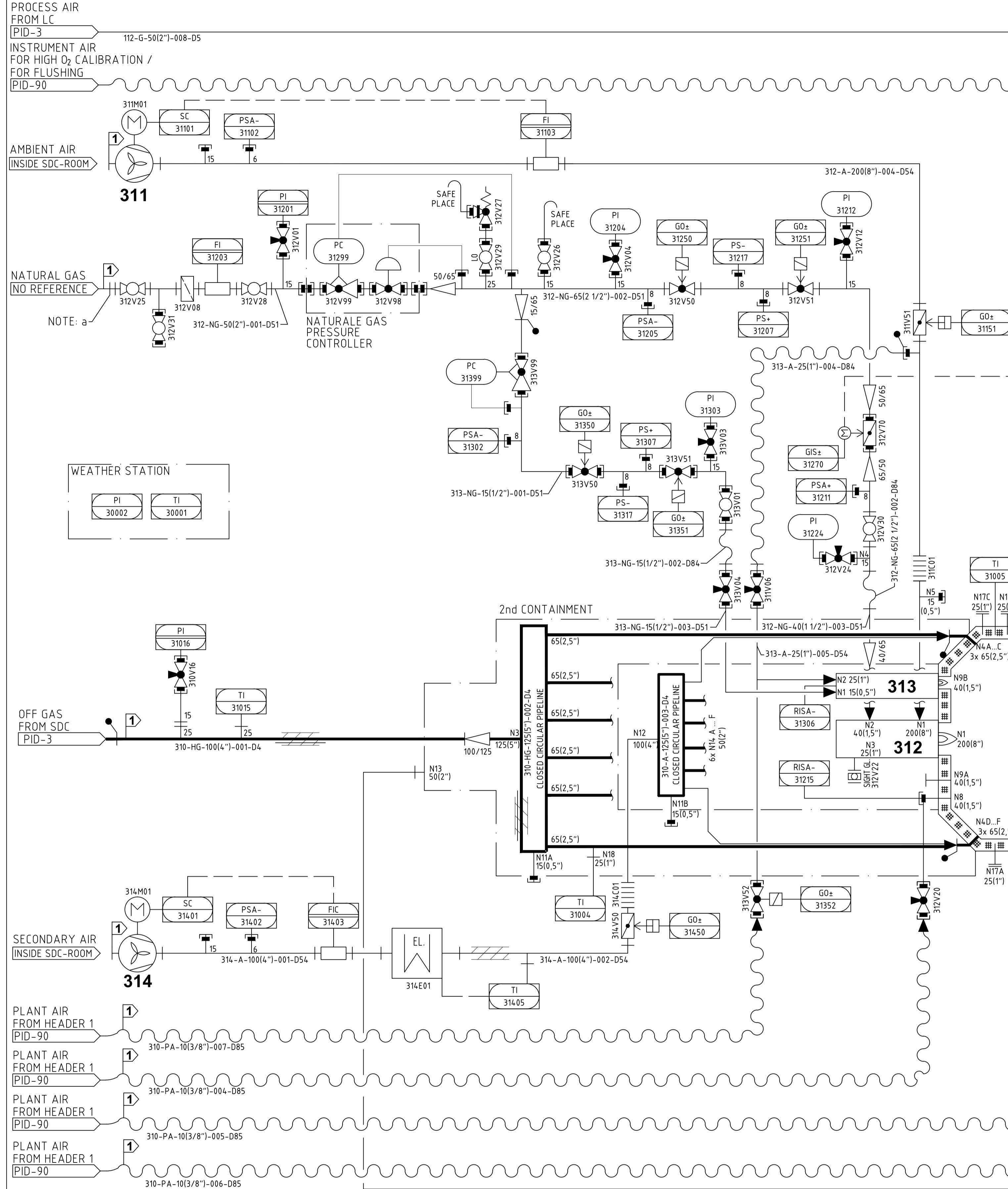
- 310 THERMAL OXIDIZER (THO)
- 311 THERMAL OXIDIZER AIR FAN (THF)
- 312 THERMAL OXIDIZER NOZZLE (THN)
- 313 IGNITION BURNER (IGB)
- 314 THERMAL OXIDIZER SECONDARY AIR FAN (SAF)
- 322 EMERGENCY WATER TANK (EWT)
- 340 QUENCH (QUE)
- 341 QUENCH PUMP 1 (QUP1)
- 342 QUENCH PUMP 2 (QUP2)
- 344 DROPLET SEPARATOR (DSE)
- 350 NEUTRAL SCRUBBER (NSC)
- 351 NEUTRAL SCRUBBER PUMP 1 (NSP1)
- 352 NEUTRAL SCRUBBER PUMP 2 (NSP2)
- 430 BLEED WATER TANK (BWT)
- 431 BLEED WATER PUMP (BWP)
- 432 AGITATOR BW (AGT)
- 480 KOH DOSING STATION (KOS)
- 481 KOH PUMP 1 (KOP1)
- 482 KOH PUMP 2 (KOP2)
- 483 KOH PUMP 3 (KOP3)

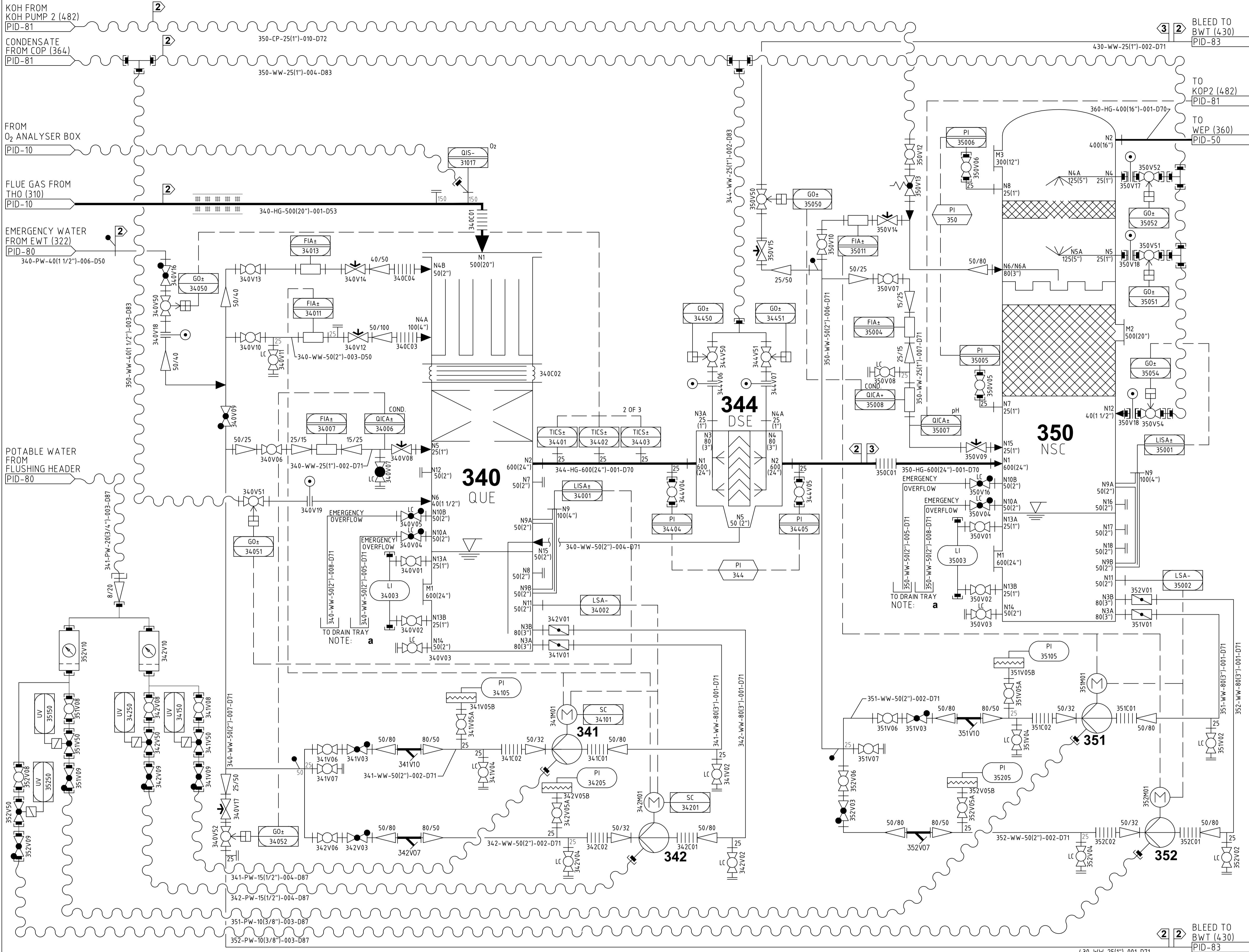
PFD-10

REV	DATE	DESCRIPTION	DRN	CHK	APP
C	2019-12-13	DD2 - 30 % DESIGN REVIEW	SR	VV	AB
B	2019-10-11	INTERIM PROJECT UPDATE < STATUS WEEK 41/19>	SR	VV	AB
A	2019-07-31	FIRST ISSUE	SR	HL	RS
REV	DATE	DESCRIPTION	DRN	CHK	APP
PROTOTYPE CHEMICAL MUNITION DESTRUCTION SYSTEM IN SUPPORT OF ASSEMBLED CHEMICAL WEAPONS ALTERNATIVES (ACWA) CHEMICAL AGENT DESTRUCTION PILOT PLANT					
BLUEGRASS ARMY DEPOT, KENTUCKY					
20501 Seneca Meadows Parkway, Suite 300, Germantown, MD 20876					
Contract Number: CWMD 1827-001					
CONTRACTOR: AECOM Management Services Inc. SUBCONTRACTOR: Dynasafe US Ltd					



THIS DOCUMENT IS PROPERTY OF DYNASAFE DEMIL SYSTEMS AB AND MUST NOT BE REPRODUCED, DISCLOSED TO ANY THIRD PARTY OR USED IN ANY UNAUTHORIZED MANNER WITHOUT WRITTEN CONSENT. © 2019 DYNASAFE DEMIL SYSTEMS AB					
MADE BY					TITLE
SR					NERVE AGENT
DATE					Process Flow Diagram
2019-07-31					Thermal Oxidizer to Neutral Scrubber
CHECKED BY	DWG STATUS	VIEW TYPE	WEIGHT	SCALE	
HL	...	PLANT	...	NTS	
PRJN. NO:	FILE NO.	DRAWING NUMBER		SIZE	REV.
2017	2017-PFD-10	2.25-2017-692513-PFD-10		A1	C



COMPONENTS:

- 340 QUENCH (QUE)
- 341 QUENCH PUMP 1 (QUP1)
- 342 QUENCH PUMP 2 (QUP2)
- 344 DROPLET SEPARATOR (DSE)
- 350 NEUTRAL SCRUBBER (NSC)
- 351 NEUTRAL SCRUBBER PUMP 1 (NSP1)
- 352 NEUTRAL SCRUBBER PUMP 2 (NSP2)

PID-40

REV.	DATE	DESCRIPTION	DRN	CHK	APP
C	2019-12-12	DD2 - 30 % DESIGN REVIEW	SR	VV	AB
B	2019-10-11	INTERIM PROJECT UPDATE (STATUS WEEK 41/19)	SR	VV	AB
A	2019-07-26	FIRST ISSUE	SR	TB	RS

REV. DATE DESCRIPTION DRN CHK APP

PROTOTYPE CHEMICAL MUNITION DESTRUCTION SYSTEM IN SUPPORT OF ASSEMBLED CHEMICAL WEAPONS ALTERNATIVES (ACWA) CHEMICAL AGENT DESTRUCTION PILOT PLANT

BLUEGRASS ARMY DEPOT, KENTUCKY

20501 Seneca Meadows Parkway, Suite 300, Germantown, MD 20876

Contract Number: CWMD 1827-001

CONTRACTOR: AECOM Management Services Inc. SUBCONTRACTOR: Dynasafe US Ltd



THIS DOCUMENT IS PROPERTY OF DYNASAFE DEMIL SYSTEMS AB AND MUST NOT BE REPRODUCED, DISCLOSED TO ANY THIRD PARTY OR USED IN ANY UNAUTHORIZED MANNER WITHOUT WRITTEN CONSENT.

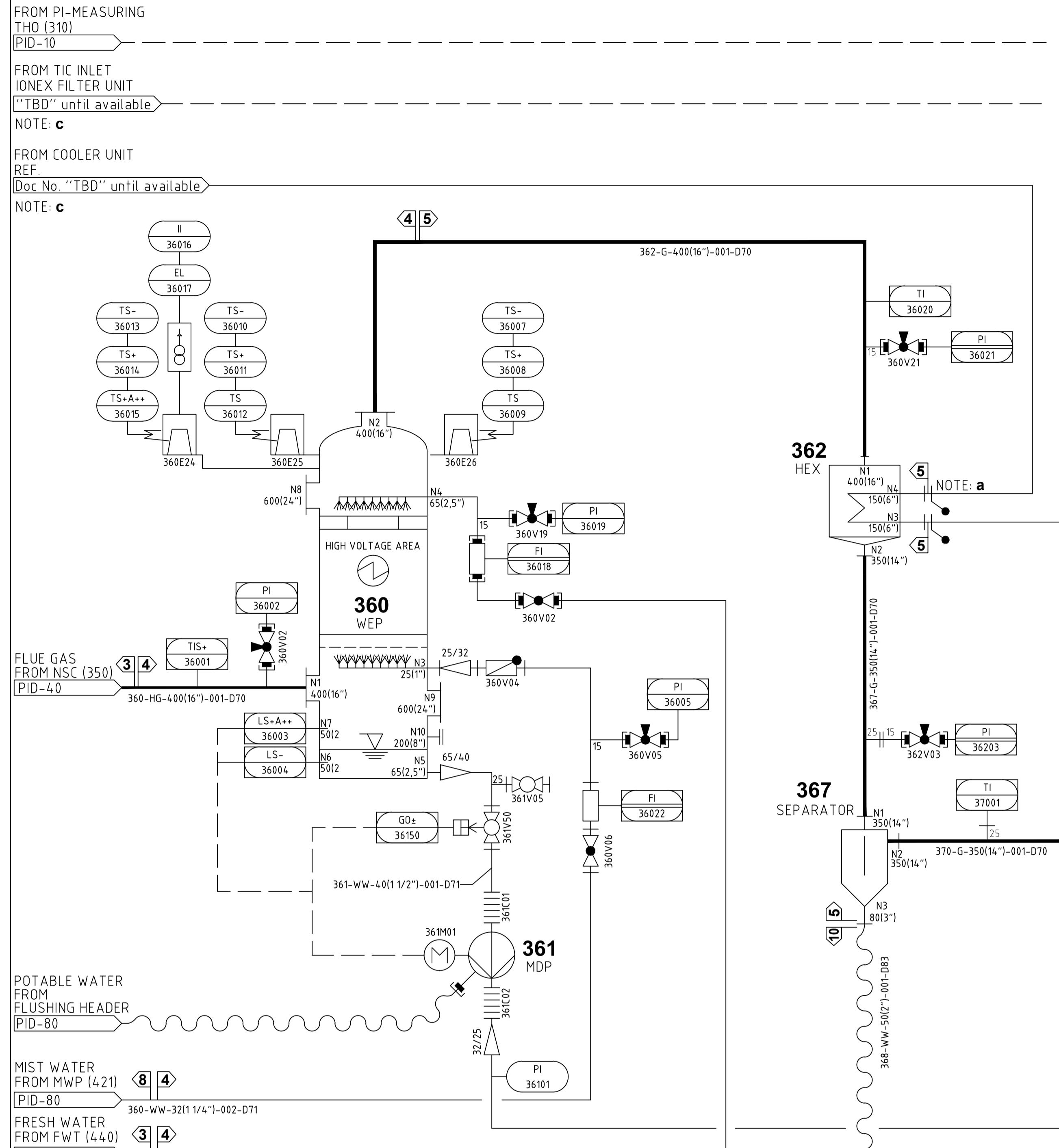
© 2019 DYNASAFE DEMIL SYSTEMS AB

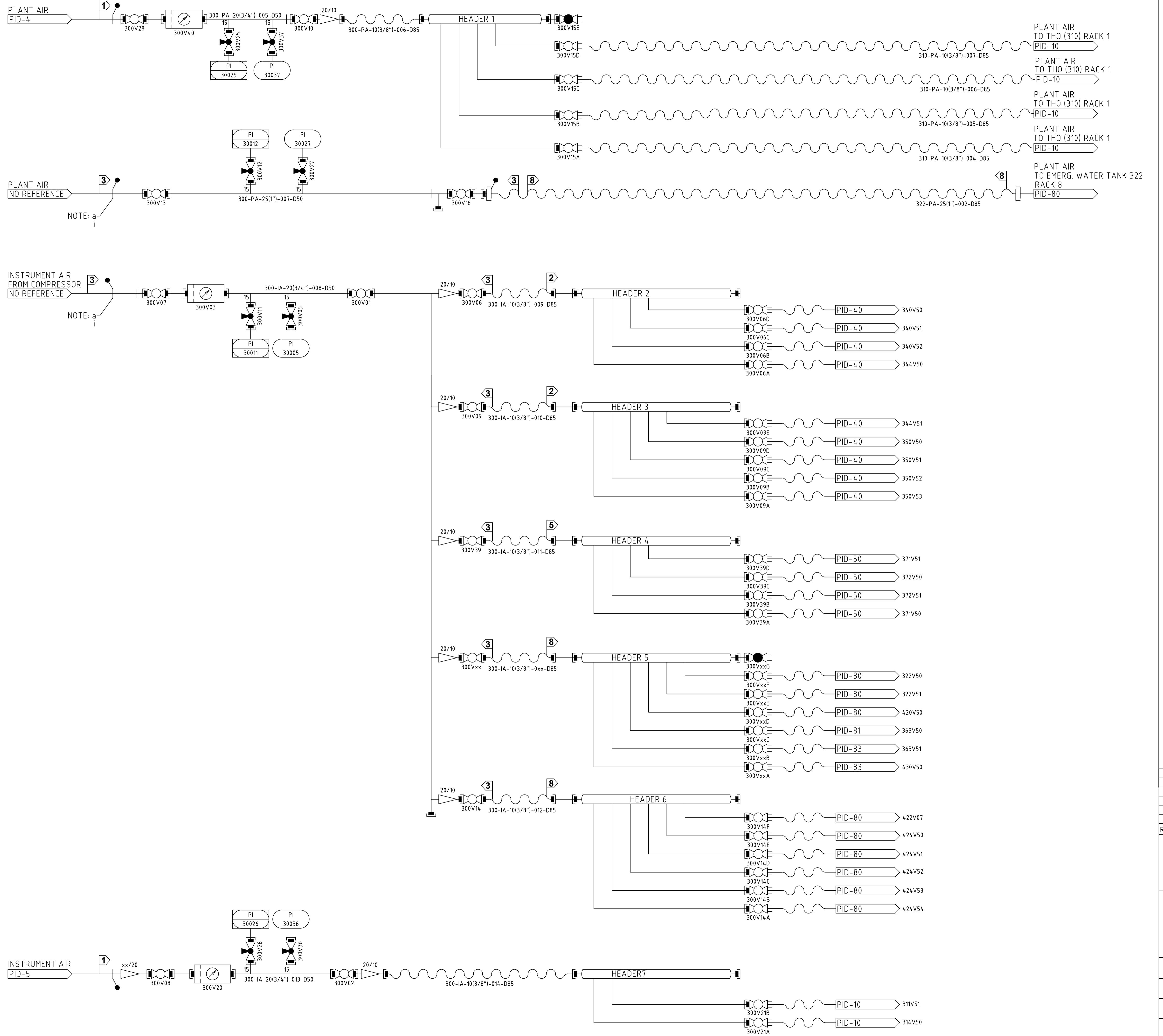
MADE BY	TITLE
SR	NERVE AGENT
DATE	Piping & Instrument Diagram
2019-07-26	Quench and Neutral Scrubber

CHECKED BY	DWG STATUS	VIEW TYPE	WEIGHT	SCALE
TB	...	PLANT	...	NTS

PRJN. NO:	FILE NO.	DRAWING NUMBER	SIZE	REV.
2017	2017-PID-40	2.2.6-2017-692518-PID-40-QUE	A1	C

COMPONENT NO.	340	341 + 342	344	350	351+352				
NAME	QUENCH	QUENCH PUMP 1+2	DROPLET SEPARATOR	NEUTRAL SCRUBBER	NEUTRAL SCRUBBER PUMP 1+2				
MEDIUM	FLUE GAS	ACID CIRCUL. WATER	FLUE GAS	FLUE GAS	NEUTR. CIRCUL. WATER				
TECHNICAL DATA	l/h --	20000	--	--	--				
	Nm ³ /h --	--							
	Scfm 11,77								
	kW 3,7	--	--	--	3,7				
	hp 4,96	--	--	--	4,96				
DESIGN PRESSURE	bar g ± 0,1		± 0,1	± 0,1					
	psi g ± 1,45		± 1,45	± 1,45					
DESIGN TEMPERATURE	°C 1150	88	100	100	88				
	°F 2102	190,4	212	212	190,4				
MATERIAL	GRAPHITE	UHMW-PE	GFK (Derakane 470-300)	GFK (Derakane 470-300)	UHMW-PE				
REMARKS			Internal coating: 2,5 mm CSS	Internal coating: 2,5 mm CSS					





NOTES: ALL DESIGN HAS BEEN DONE BASED ON SI-UNITS

1 **N** = RACK 1...N

a: ANSI FLANGE CONNECTION
i: INTERFACE POINT

PID-90

DATE	DESCRIPTION	SR	VV	AR	
✓	DATE	DESCRIPTION	DRN	CHK	AR
2019-12-12	DD2 - 30 % DESIGN REVIEW	SR	VV	AR	
2019-10-11	INTERIM PROJECT UPDATE (STATUS WEEK 41/19)	SR	VV	AR	
2019-07-31	FIRST ISSUE	SR	HL	RE	

PROTOTYPE CHEMICAL MUNITION DESTRUCTION SYSTEM IN SUPPORT OF ASSEMBLED CHEMICAL WEAPONS ALTERNATIVES (ACWA) CHEMICAL AGENT DESTRUCTION PILOT PLANT
BLUEGRASS ARMY DEPOT, KENTUCKY
20501 Seneca Meadows Parkway, Suite 300, Germantown, MD 20876
Contract Number: CWMD 1827-001
CONTRACTOR: AECOM Management Services Inc. SUBCONTRACTOR: Dynasafe US Ltd

AECOM | **DYNASAFE**

DOCUMENT IS PROPERTY OF DYNASAFE DEMIL SYSTEMS AB AND MUST NOT BE REPRODUCED, DISCLOSED TO
THIRD PARTY OR USED IN ANY UNAUTHORIZED MANNER WITHOUT WRITTEN CONSENT.

NERVE AGENT

NERVE AGENT

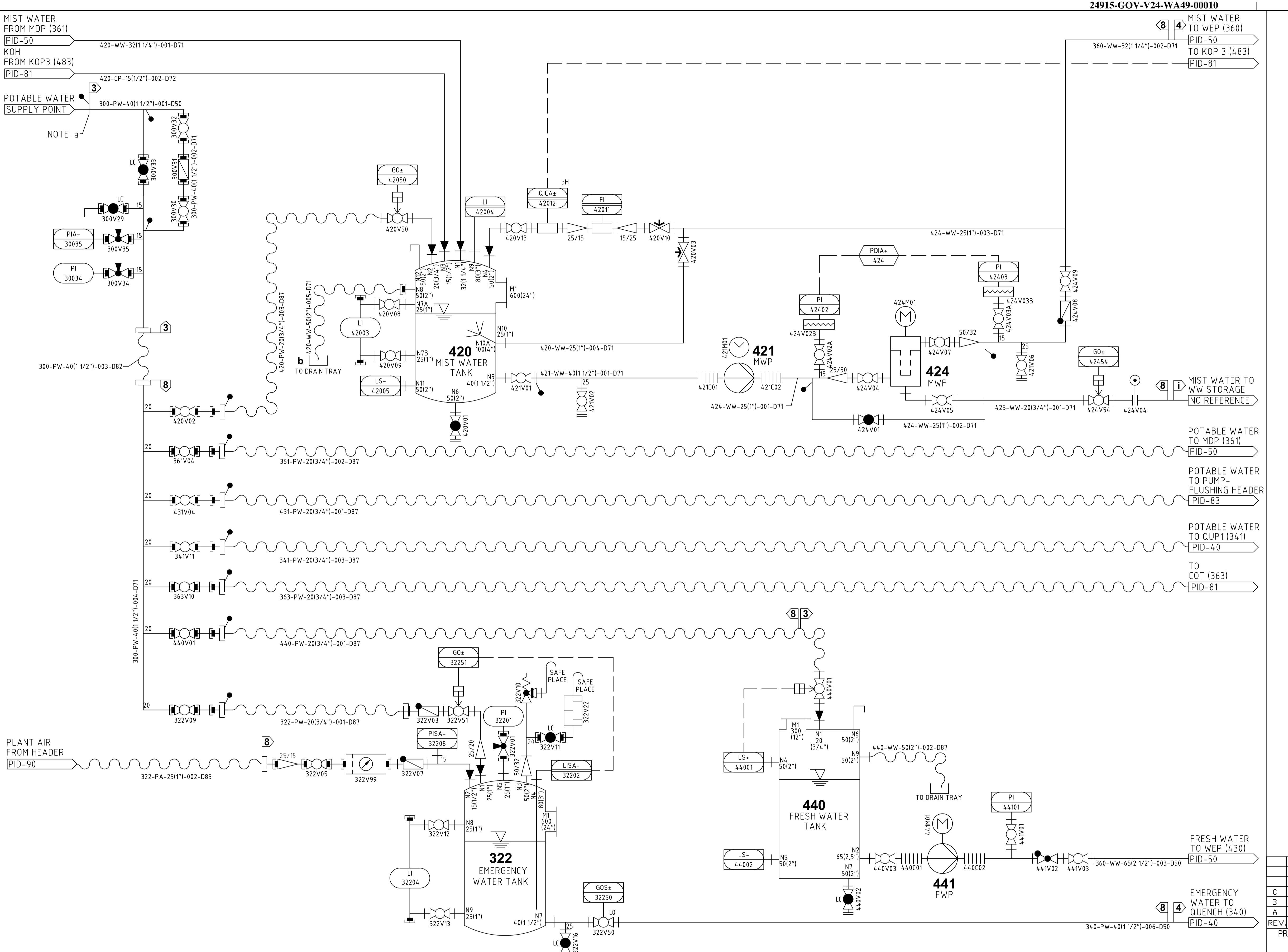
Sampling & Instrument Diagram

Water Plant Air and Instrument Air

VIEW TYPE	WEIGHT	SC
-----------	--------	----

PLANT	...	M
DRAWING NUMBER		SIZE

DRAWING NUMBER SIZE
2.6-2017-692560-PID-90-HEA A1



NOTES: ALL DESIGN HAS BEEN DONE BASED ON SI-UNITS
ALL DIMENSIONS IN INCHES

1 **N** = RACK 1...N

REFER PID-90 FOR PNEUMATIC DRIVES IA CONNECTION
a: ANSI FLANGE CONNECTION
b: DRAIN TRAY IS IN THE FORM OF RACK CONTAINMENT
i: INTERFACE POINT

COMPONENTS:

- 322** EMERGENCY WATER TANK (EWT)
 - 420** MIST WATER TANK (MWT)
 - 421** MIST WATER PUMP (MWP)
 - 424** MIST WATER FILTER (MWF)
 - 440** FRESH WATER TANK (FWT)
 - 441** FRESH WATER PUMP (FWP)

PID-80

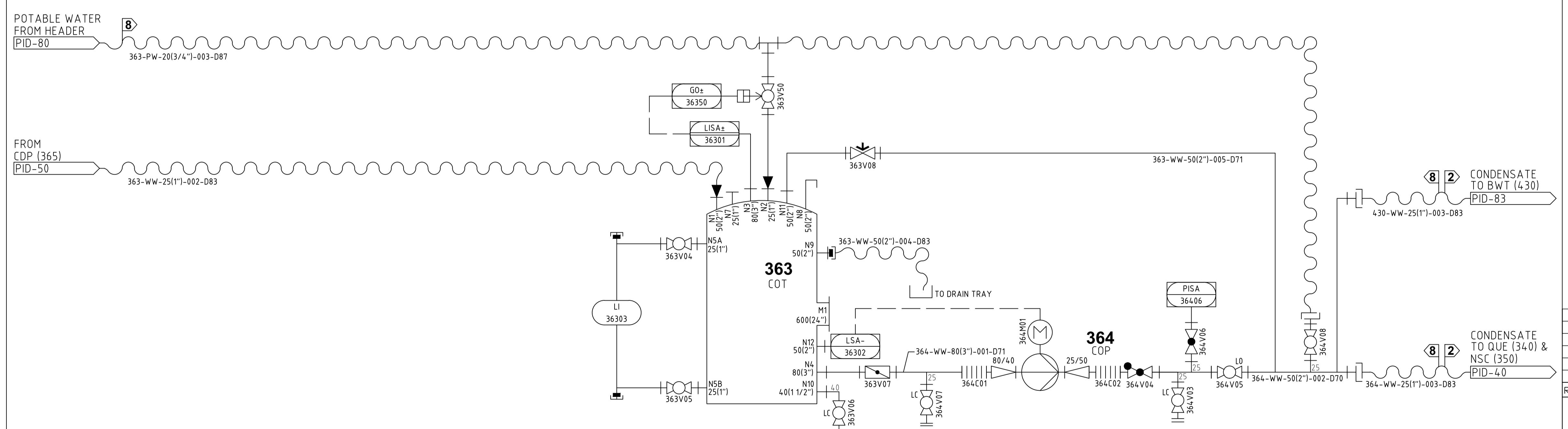
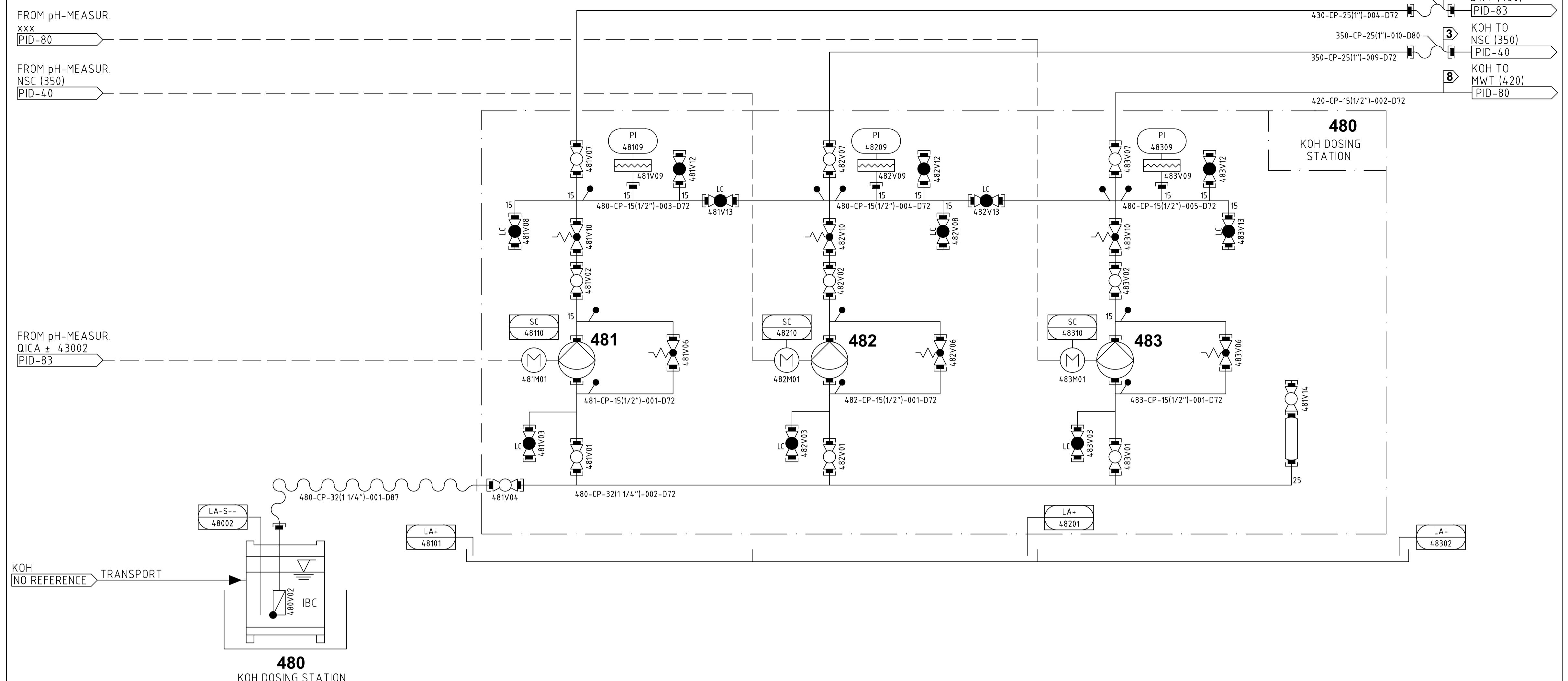
DATE	DESCRIPTION	SR	VV	AB
2019-12-12	DD2 - 30 % DESIGN REVIEW	SR	VV	AB
2019-10-11	INTERIM PROJECT UPDATE (STATUS WEEK 41/19)	SR	VV	AB
2018-07-31	FIRST ISSUE	SR	HL	RS
		DRN	CHK	API

ROTOTYPE CHEMICAL MUNITION DESTRUCTION SYSTEM IN SUPPORT OF ASSEMBLED CHEMICAL WEAPONS ALTERNATIVES (ACWA) CHEMICAL AGENT DESTRUCTION PILOT PLANT
BLUEGRASS ARMY DEPOT, KENTUCKY
20501 Seneca Meadows Parkway, Suite 300, Germantown, MD 20876
Contract Number: CWMD 1827-001

S DOCUMENT IS PROPERTY OF DYNASAFE DEMIL SYSTEMS AB AND MUST NOT BE REPRODUCED, DISCLOSED
THIRD PARTY OR USED IN ANY UNAUTHORIZED MANNER WITHOUT WRITTEN CONSENT.
2019 DYNASAFE DEMIL SYSTEMS AB

MADE BY SR	TITLE NERVE AGENT Piping & Instrument Diagram EWT
DATE 2018-07-31	

HECKED BY HL	DWG STATUS ...	VIEW TYPE PLANT	WEIGHT ...	SCALE NTS
PROJ. NO: 2017	FILE NO. 2017-PID-80	DRAWING NUMBER 2.2.6-2017-692606-PID-80-TR	SIZE A1	RE C



COMPONENT NO.	363	364	481	482	483					
NAME	CONDENSATE TANK	CONDENSATE PUMP	KOH PUMP 1	KOH PUMP 2	KOH PUMP 3					
MEDIUM	WATER	WATER	KOH	KOH	KOH					
TECHNICAL DATA	l/h -- Nm ³ /h 4,0 m ³ Scfm 1056,69 gal	20000 -- 88,06 gal/min								
DESIGN PRESSURE	bar g ±0,10 psi g ± 1,45	2,00 29,01								
DESIGN TEMPERATURE	°C 100	88								
MATERIAL	FRP	UHME-PE								
REMARKS										

NOTES: ALL DESIGN HAS BEEN DONE BASED ON SI-UNITS
ALL DIMENSIONS IN INCHES

① N = RACK 1...N

REFER PID-90 FOR PNEUMATIC DRIVES IA CONNECTION

COMPONENTS:

- 363 CONDENSATE TANK (COT)
- 364 CONDENSATE PUMP (COP)
- 480 KOH DOSING STATION (KOS)
- 481 KOH PUMP 1 (KOP1)
- 482 KOH PUMP 2 (KOP2)
- 483 KOH PUMP 3 (KOP3)

REV.	DATE	DESCRIPTION	DRN	CHK	APP
C	2019-12-12	DD2 - 30 % DESIGN REVIEW	SR	VV	AB
B	2019-10-11	INTERIM PROJECT UPDATE (STATUS WEEK 41/19)	SR	VV	AB
A	2019-07-31	FIRST ISSUE	SR	HL	RS

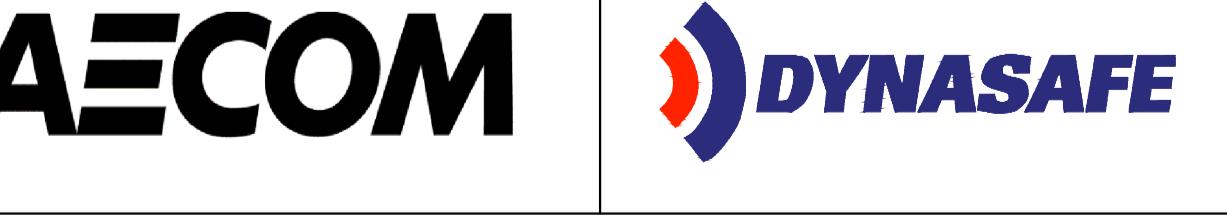
PROTOTYPE CHEMICAL MUNITION DESTRUCTION SYSTEM IN SUPPORT OF ASSEMBLED CHEMICAL WEAPONS ALTERNATIVES (ACWA) CHEMICAL AGENT DESTRUCTION PILOT PLANT

BLUEGRASS ARMY DEPOT, KENTUCKY

20501 Seneca Meadows Parkway, Suite 300, Germantown, MD 20876

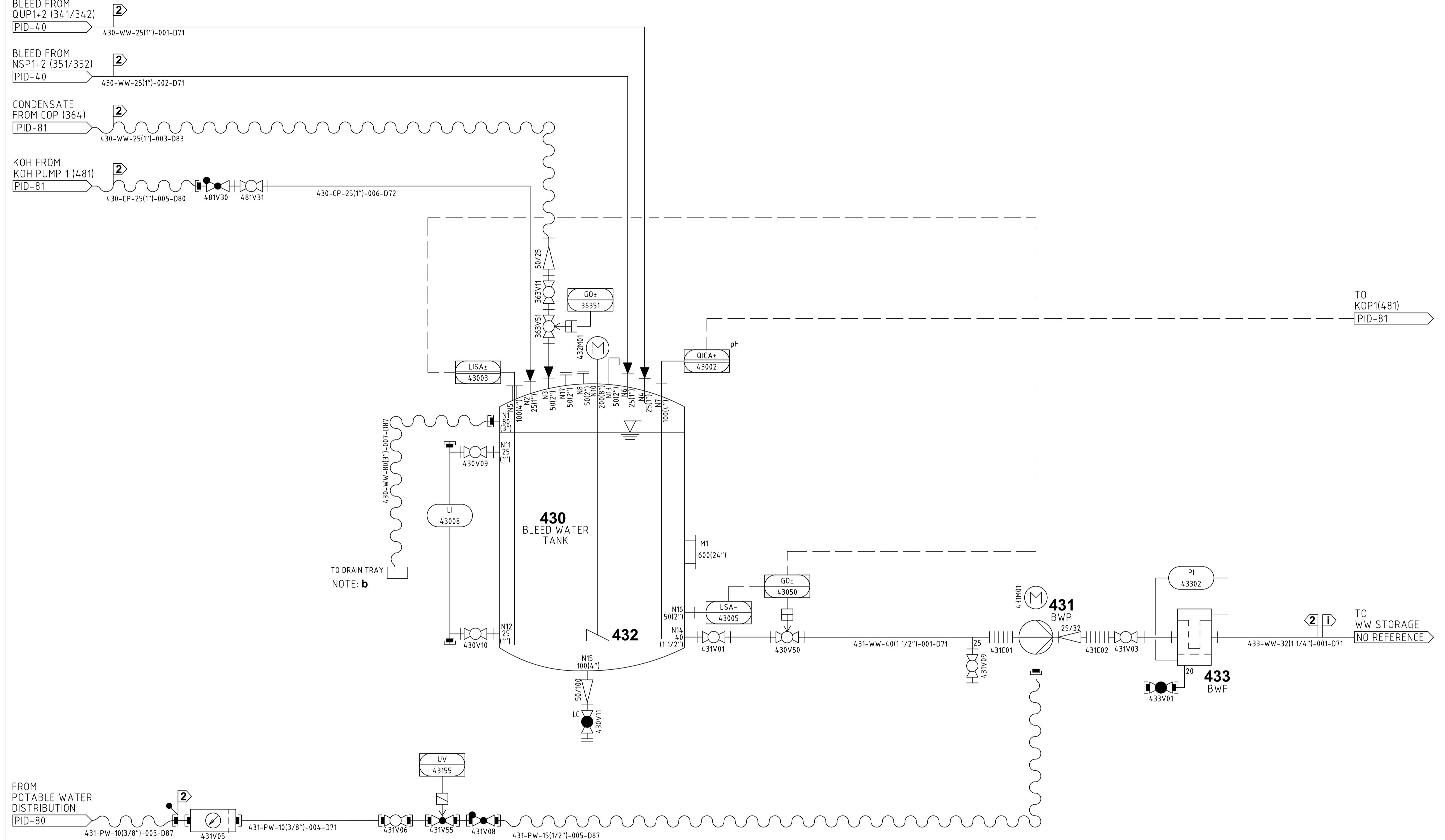
Contract Number: CWMD 1827-001

CONTRACTOR: AECOM Management Services Inc. SUBCONTRACTOR: Dynasafe US Ltd



THIS DOCUMENT IS PROPERTY OF DYNASAFE DEMIL SYSTEMS AB AND MUST NOT BE REPRODUCED, DISCLOSED TO ANY THIRD PARTY OR USED IN ANY UNAUTHORIZED MANNER WITHOUT WRITTEN CONSENT.
© 2019 DYNASAFE DEMIL SYSTEMS AB

MADE BY	TITLE
SR	NERVE AGENT
	Piping & Instrument Diagram
	COT and KOH Dosing Station
DATE	
2019-07-31	
CHECKED BY	DWG STATUS
HL	VIEW TYPE
	WEIGHT
	SCALE
PROJ. NO:	FILE NO.
2017	2.2.6-2017-692607-PID-81-KDS
REV.	SIZE
C	A1



NOTES: ALL DESIGN HAS BEEN DONE BASED ON SI-UNITS
ALL DIMENSIONS IN INCHES

1 | **N** = RACK 1...N

REFER PID-90 FOR PNEUMATIC DRIVES IA CONNECTION

a: ANSI FLANGE CONNECTION

b: DRAIN TRAY IS IN THE FORM OF RACK CONTAINMENT

i: INTERFACE POINT

COMPONENTS:

- 430** BLEED WATER TANK (BWT)
 - 431** BLEED WATER PUMP (BWP)
 - 432** AGITATOR BW (AGT)
 - 433** BLEED WATER FILTER (BWF)

PID-83

2019-12-12	DD2 - 30 % DESIGN REVIEW	SR	VV	AB
2019-10-11	INTERIM PROJECT UPDATE (STATUS WEEK 41/19)	SR	VV	AB
2019-07-31	FIRST ISSUE	SR	HL	RS
/ DATE	DESCRIPTION	DRN	CHK	APL

TYPE CHEMICAL MUNITION DESTRUCTION SYSTEM IN SUPPORT OF ASSEMBLED CHEMICAL WEAPONS ALTERNATIVES (ACWA) CHEMICAL AGENT DESTRUCTION PILOT PLANT
BLUEGRASS ARMY DEPOT, KENTUCKY

BLUEGRASS ARMY DEPOT, KENTUCKY
20501 Seneca Meadows Parkway, Suite 300, Germantown, MD 20876
Contract Number: CWMD 1827-001

CONTRACTOR: AECOM Management Services Inc. SUBCONTRACTOR: Dynasafe US Ltd

Table 1. Summary of the main characteristics of the four groups of patients.

ANSWER | 3

AECOM | **DYNASAFE**

AECOM | **DYNASAFE**

[View Details](#) | [Edit](#) | [Delete](#)

DOCUMENT IS PROPERTY OF DYNASAFE DEMIL SYSTEMS AB AND MUST NOT BE REPRODUCED, DISCLOSED, OR USED FOR ANY OTHER PURPOSE.

DYNASAFE DEMIL SYSTEMS AB

© DYNASHIELD SECURITY SYSTEMS AB

NERVE AGENT Piping & Instrument Diagram

Piping & Instrument Diagram BWT

-07-31 BWI

ED BY DWG STATUS VIEW TYPE WEIGHT SCALE
HL ... PLANT ... NTS

FILE NO.: DRAWING NUMBER: SIZE: REV:

017 2017-PID-83 2.2.6-2017-692608-PID-83-TR A1 C



Mass Balance

SDC 1200 and OTs



ENGINEER, PROCURE AND CONSTRUCT (EPC) SUBCONTRACT STATIC DETONATION CHAMBER UNITS

NERVE AGENT

20501 Seneca Meadows Parkway, Suite 300, Germantown, MD 20876

Contract Number. CWMD 1827-001

CONTRACTOR: AECOM Management Services Inc. SUBCONTRACTOR: Dynasafe US Ltd.

Summary

Feed 1 to SDC

Feed		Pieces		
Name		3.00	feed/h	
Type	M55	2	Pc/feed	
Metal		6	Pc/h	
Organic				
Propellant				
Explosives				
Fuze explosives				
Overpack				
Box (PP)				

Detailed Munition data per piece

Part Name	lb/pc	kg/pc	kg/h	lbs/h
Total Projectile	20.54	9.32	55.89	
Projectile	15.83	7.18	43.08	
Paint	0.08	0.04	0.22	
Agent (GB)	0.54	0.24	1.46	3.23
Burster M34 (Comp B)	2.70	1.22	7.35	
Burster M36 (Comp B)	0.50	0.23	1.36	
Fuze M417	0.42	0.19	1.14	
Heavy metals impurities	0.00	0.00	0.00	
Burster and Fuse metal	0.47	0.21	1.28	
Cannister (overpack)				
Metal	33.89	15.37	92.22	
Butyl Plug		0.0546	0.33	
Cardboard plug		0.018	0.11	
Plastic wrapping		0.057	0.34	
Unknown	0.00	0.00	0.00	
Total	54.42	24.81	148.89	

Only Agent 0.54 0.24 1.46

Details of the Feed tray/Box	
L	1 m
W	0.3 m
B	0.3 m
Thickness	2 mm
PP Box weight	2.5116 kg

Air Flow SDC

	Nm ³ /h	kmol/h	kg/h
Combustion air	180	8.03	231.69
Air to LC1	15	0.67	19.31
Air to LC2	15	0.67	19.31
Total air SDC	210	9.37	
N2	165.9	7.40	207.35
O2	44.1	1.97	62.96

Element	mg/kg Agent	total mg/pc	mg/h	kg/h	kmol/kg	kmol/h
Al	0	0.0	0.00	0.00	26.98	0.000
Sb	0	0.0	0.00	0.00	121.76	0.000
As	0	0.0	0.00	0.00	74.92	0.000
Ba	0	0.0	0.00	0.00	137.33	0.000
Be	0	0.0	0.00	0.00	9.01	0.000
B	0	0.0	0.00	0.00	10.81	0.000
Cd	0	0.0	0.00	0.00	112.41	0.000
Cr	0	0.0	0.00	0.00	52.00	0.000
Co	0	0.0	0.00	0.00	58.93	0.000
Cu	0	0.0	0.00	0.00	63.55	0.000
Fe	0	0.0	0.00	0.00	55.85	0.000
Pb	0	0.0	0.00	0.00	207.20	0.000
Mn	0	0.0	0.00	0.00	54.94	0.000
Hg	0	0.0	0.00	0.00	200.59	0.000
Ni	0	0.0	0.00	0.00	58.69	0.000
P	0	0.0	0.00	0.00	30.97	0.000
Se	0	0.0	0.00	0.00	78.97	0.000
Ag	0	0.0	0.00	0.00	107.87	0.000
Th	0	0.0	0.00	0.00	232.04	0.000
Sn	0	0.0	0.00	0.00	118.71	0.000
V	0	0.0	0.00	0.00	50.94	0.000
Zn	0	0.0	0.00	0.00	65.38	0.000
Total		0.0				

SI Units
SDC streams

Stream No.		1					1A	2	3	4	5	6	12	
		TOTAL SUBCOMPOSITION											SCRAP FOR DISPOSAL	
Medium		MUNITIONS	EXPLOSIVES	Agent GB	METAL (munition bodies)	PACKING (PP Tray)	Overpack container (Metal + Butyl)	Plant Air	Plant Air	OFFGAS FROM SDC to BT	OFFGAS TO OGT	DUST FROM BUFFERTANK	METAL (projectile bodies)	DUST
From		Feed conveyor					Compressor	Air Heater	SDC	BT	BT	SDC 1200		
To		SDC 1200					AIR HEATER	SDC 1200	BT	THO	Dust Drum BT	Scrap SDC 1200		
Amount	kg/h	54.61	9.85	1.46	43.30	7.53	93.00	231.69	231.69	292.88	292.88	1.37	132.51	1.34
	kmol/h							8.03	8.03	10.20	10.20	0.02	2.37	0.02
	Nm ³ /h							180.00	180.00	224.68	224.68	0.00	-	-
Pressure	kPa (g)							600.00	300.00	Variable	Variable	NA	-	-
Temperature	°C	20.00	20.00	20.00	20.00	20.00	20.00	20.00	500.00	550.00	550.00	350.00	30-300	30-300
Operative flow	m ³ /h							121.32	393.08	409.49	409.49	-	-	
Duct diameter	m									0.08	0.08	0.1	-	
Duct velocity	m/s									30.4	30.4	-	-	
Pressure drop	kPa									1.0	-	-	-	
Pollutants														
CO	kg/h	-	-	-	-	-	-	-	-	0.47	0.47	-	-	-
NOx	kg/h	-	-	-	-	-	-	-	-	0.98	0.98	-	-	-
HCl	kg/h	-	-	-	-	-	-	-	-	0.00	0.00	-	-	-
SOx	kg/h	-	-	-	-	-	-	-	-	0.00	0.00	-	-	-
TOC	kg/h	-	-	-	-	-	-	-	-	2.44	2.44	-	-	-
Dust	kg/h	-	-	-	-	-	-	-	-	2.73	2.73	1.37	-	-
PCDD/PCDF	µg/h	-	-	-	-	-	-	-	-	10.00	7.13	1.00	-	10.00
Composition														
Offgas														
N2	Nm ³ /h	-	-	-	-	-	-	142.20	142.20	167.97	167.97	-	-	-
O2	Nm ³ /h	-	-	-	-	-	-	37.80	37.80	27.94	27.94	-	-	-
CO2	Nm ³ /h	-	-	-	-	-	-	-	-	12.28	12.28	-	-	-
CO	Nm ³ /h	-	-	-	-	-	-	-	-	0.38	0.38	-	-	-
Nox	Nm ³ /h	-	-	-	-	-	-	-	-	0.73	0.73	-	-	-
HCl	Nm ³ /h	-	-	-	-	-	-	-	-	0.00	0.00	-	-	-
SO2	Nm ³ /h	-	-	-	-	-	-	-	-	0.00	0.00	-	-	-
H2O	Nm ³ /h	-	-	-	-	-	-	-	-	0.05	0.05	-	-	-
As-X	Nm ³ /h	-	-	-	-	-	-	-	-	0.00	0.00	-	-	-
CH4	Nm ³ /h									1.51	1.51	-	-	-
Others	Nm ³ /h	-	-	-	-	-	-	-	-	13.80	13.80	-	-	-
P	kg/h				0.26					0.30	0.30	-		0.0
Cl	kg/h	-	-		0.00	-	-	-	-	0.00	0.00	-	-	0.0
S	kg/h	-	-		0.00	-	-	-	-	0.00	0.00	-	-	0.0
F	kg/h				0.16					0.16	0.16			0.0

Stream No	7	8	9	10	11	13	14		16	17	18	
Medium/ Description	PROCESS VENTILATION FROM SCRAP CABINET	PROCESS VENTILATION AFTER FILTER	PROCESS VENTILATION AFTER FAN	DUST FROM CYCLONE	DUST FROM FILTER	PROCESS VENTILATION FROM SCRAP INSPECTION	FLUSHING AIR OF LC1 & LC2 AND PURGING OF SENSORS		PROCESS VENTILATION FROM SCRAP CABINET	PROCESS VENTILATION FROM BUFFER TANK	ASPIRATION FROM THO	
From												
To												
Amount	kg/h	4874.63	10713.64	10713.64	0.10	0.10	2786.42	30.00	4874.63	642.92	321.46	
	kmol/h	169.14	371.74	371.74			96.68	1.34	169.14	22.31	11.15	
	Nm³/h	3791.00	8332.00	8332.00			2167.00	30.00	3791.00	500.00	250.00	
Pressure	kPa (g)	-2.50	-4.00	0.00			-0.04	600.00	-2.50	-0.05	-0.04	
Temperature	°C	100.00	30.00	30.00	30.00	30.00	30.00	20.00	100.00	30.00	30.00	
Operative flow	m³/h	5259	9405	9367			2436	20	5259	562	281	
Duct diameter	m											
Duct velocity	m/s											
Pressure drop	kPa											
Pollutants												
CO	kg/h											
NOx	kg/h											
HCl	kg/h											
SOx	kg/h											
TOC	kg/h											
Dust	kg/h				0.1	0.1						
PCDD/PCDF	µg/h											
Composition												
N2	Nm³/h	2994.89	6582.28	6582.28			1711.93	23.7	2994.89	395	197.5	
O2	Nm³/h	796.11	1749.72	1749.72			455.07	6.3	796.11	105	52.5	

OTS Streams

Main Offgas streams

Side streams OTS air and gaseous utilities

Stream No		70	71	72	78
Medium		NG	Air	Air	Plant air
From	NG header	THF	SAF		Header PA
To	THO	THO	THO		THO
Amount	kg/h	46.42	1158.46	386.15	0.0
	kmol/h	2.68	40.15	13.38	0.0
	Nm³/h	60.00	900.00	300.00	10
Pressure	kPa	250-0.5	3.00	5.00	150
Temperature	°C	20.00	20.00	20.00	20
Operative flow	m³/h	60.00	976	325	10.87
Duct diameter	m	0.04	0.20	0.13	0.01
Duct velocity	m/s	13.26	8.63	7.35	38.5
Pressure drop	kPa				
Composition					
N2	Nm³/h	-	900.00	386.15	7.9
O2	Nm³/h	-	300.00	296.21	2.1
CH4	Nm³/h	60.00			

Side streams OTS Fluids and liquid utilities

Stream No		80	81	82	83	84	85	86	87	88	89	90 & 90A	91	92
Fluids/ Utilities		Potable water	Emergency water	Potable water	Potable water	Potable water	Scrubbing water	Scrubbing water	Scrubbing water	Scrubbing water	Condensate	Water	Water	Process water
From	Supply	Header	Header	Header	Header	Header	QUE sump	QUE sump	NSC sump	NSC sump	HEX	Header	Header	BWT
To	Header	EWT	COT	MWT	FWT	Quench	BWT	NSC top	BWT	TCS	ASC top	NSC top	NSC top	WWS (ext)
Amount	kg/h	714.9	Variable	348.2	200	167	20000	76.24	15000	59.57	726	1015	59.2	135.3
	kmol/h	39.7		19.3	11.10	9	1110	-	833	3.3	40.3	56.3	3.3	7.5
	m³/h	0.71			0.20	0	20	0.07	15	0.06	0.73	1.01	0.06	0.13
Pressure	kPa	300.0	600.0	300.0	300.0	300.0	260.0	260.0	260.0	260.0	40.0	260.0	260.0	260.0
Temperature	°C	20.0	20.0	20.0	20	20	79	78.8	79.0	79.0	30.2	20.0	20.0	50.0
Pressure drop	kPa													
pH		7	7	7	7	7	2	2	6.5	6.5	6.5	7	7	7.5
Viscosity	centipoise	1	1	1	1	1	0.36	0.36	0.36	0.36	1	1	1	0.55
Composition														
H2O	kg/h	715		348.18	200.00	166.67	Internal circulation stream	74.0	Internal circulation stream	59.21	726	1015	59	135.28
HCl	kg/h					-		-		-				-
HF/HBr	kg/h					-		-		-				-
H3PO4	kg/h					-		0.28		-				-
Dissolved solids														
KCl	kg/h		-		-									-
KF	kg/h			-		-				0.359				0.359
K2SO3	kg/h		-		-									-
K2SO4	kg/h		-		-					1.42				2.03
Non dissolved solids														-
Heavy metals	mg/h		-		-			1884342.95		-				1884343.0

WWS (ext):
External waste
water storage

Side streams OTS Fluids and liquid utilities

Stream No		93	94	95	96	97	98*
Fluids/ Utilities		Waste Water	Potable water				
From		MWT	MWP	MWP	MWP	WEP	FWT
To		MWP	WEP	MWT	WWS (ext)	MWT	WEP
Amount	kg/h	10966.7	2400.0	8200	367	2424	24000
	kmol/h	608.75	133.2	455.18	20.35	134.6	1332.2
	m³/h	10.86	2.38	8.12	0.36	2.43	24.00
Pressure	kPa	240.0	240.0		240.0	240.0	300.0
Temperature	°C	76.0	79.0		79	80	20
Pressure drop	kPa	-					
pH		7	7		7	6	7
Viscosity	centipoise	1	1		1	1	1
Composition							
H2O	kg/h	10966.7	2400.00	8200.00	366.67	2424.32	24000
HCl	kg/h						
HF/HBr	kg/h				Traces	Traces	
KOH	kg/h						
Glycol	kg/h						
Dissolved solids							
NaCl	kg/h		-				
KF	kg/h				Traces	Traces	
K2SO3	kg/h		-				
K2SO4	kg/h		-				
Non dissolved solids							
Heavy metals and phosphor compounds	mg/h		-		73057.8		

WWS (ext):
External waste
water storage

* Flow once in 12 hours for 4-5 min

BALANCE	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	T*S MJ	G MJ	Ex Phys MJ	Ex Chem MJ	EXERGY MJ
IN1			12.066	426.729	210.354	134.30	109.93	1644.580	-1534.647	49.954	1489.761	1540
OUT1			12.596	426.729	224.698	408.67	46.69	1987.721	-2141.029	95.128	1113.479	1209
BALANCE			0.531	0.000	14.345	274.37	-63.24	343.141	-606.382	45.173	-376.282	-331
IN2			10.200	292.885	224.681	101.96	-260.03	1359.970	-1619.994	38.197	216.389	255
OUT2			10.200	292.885	224.681	101.96	-260.03	1359.970	-1619.994	38.197	216.389	255
BALANCE			0.000	0.000	0.000	0.00	0.00	0.000	0.000	0.000	0.000	0
IN3			66.391	1882.559	1484.681	164.28	-388.64	5107.480	-5496.118	52.901	2484.564	2537
OUT3			66.291	1882.559	1485.545	2461.90	-388.70	22341.206	-22779.900	1473.751	143.961	1618
BALANCE			-0.100	0.000	0.864	2297.62	-0.06	17233.726	-17283.782	1420.849	-2340.603	-920
IN4			1176.460	21882.559	1505.606	6917.75	-313252.36	54562.226	-367814.781	1837.487	1186.316	3024
OUT4			1176.457	21882.559	2671.889	4626.60	-313252.34	39146.796	-352429.439	875.698	1185.981	2062
BALANCE			-0.002	0.000	1166.284	-2291.15	0.02	-15415.430	15385.342	-961.789	-0.335	-962
IN5			951.199	17823.555	2667.818	3598.06	-249891.54	32432.824	-282324.409	788.938	974.425	1763
OUT5			951.194	17823.555	2626.659	3680.68	-249891.56	32456.657	-282378.695	780.940	973.094	1754
BALANCE			-0.005	0.000	-41.159	82.62	-0.02	23.833	-54.286	-7.998	-1.331	-9
IN6			249.738	5185.087	2613.984	724.68	-52336.92	11932.626	-64270.158	539.002	313.471	852
OUT6			249.738	5185.087	2583.750	784.18	-52336.82	11932.794	-64299.576	531.707	313.471	845
BALANCE			0.000	0.000	-30.234	59.51	0.10	0.167	-29.418	-7.295	0.000	-7
IN7			4348.323	92760.693	2670.960	-5055.28	-1279434.55	91292.053	#####	623.010	444871.095	445494
OUT7			4348.323	92760.693	1768.957	-3284.72	-1279436.30	92339.924	#####	183.479	444871.095	445055
BALANCE			0.000	0.000	-902.002	1770.55	-1.75	1047.871	-1051.445	-439.531	0.000	-440
IN8			74.891	2035.110	1678.588	79.87	-4836.73	4653.958	-9524.970	126.670	149.288	276
OUT8			74.891	2035.110	1678.588	79.86	-4836.74	4908.457	-9745.212	129.559	149.288	279
BALANCE			0.000	0.000	0.000	-0.01	-0.01	254.499	-220.242	2.889	0.000	3
IN9			74.891	2035.110	1678.588	79.86	-4836.74	4908.456	-9745.212	129.559	149.288	279
OUT9			74.891	2035.110	1678.588	79.90	-4836.70	4871.528	-9713.231	129.052	149.288	278
BALANCE			0.000	0.000	0.000	0.04	0.04	-36.928	31.981	-0.507	0.000	-1

INPUT SPECIES (1) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 1 Agent	20.000		0.010	1.463	0.199	-0.01	-8.50				
C4H10FO2P(Sg)	20.000		0.008	1.174	0.188	-0.01	-8.08	-0.808	-963.965	140.093	0.006
C4H8Cl2S(g)	20.000		0.000	0.000	0.000	0.00	0.00	-0.681	-125.451	159.077	0.007
C7H5N5O8(T)	20.000		0.000	0.000	0.000	0.00	0.00	-1.510	39.493	287.143	#####
C7H6N2O	20.000		0.000	0.026	0.000	0.00	0.00	0.000	0.000	134.135	#####
C7H17O3P	20.000		0.001	0.164	0.000	0.00	0.00	0.000	0.000	180.182	#####
HF(l)	20.000		0.000	0.003	0.000	0.00	-0.05	-0.258	-303.258	20.006	#####
C12H27N(1DAg)	20.000		0.000	0.039	0.005	0.00	-0.06	-1.495	-268.495	185.349	0.008
C3H7F(1FPg)	20.000		0.000	0.000	0.000	0.00	0.00	-0.409	-284.209	62.086	0.003
CHCl3(l)	20.000		0.000	0.001	0.000	0.00	0.00	-0.584	-135.054	119.378	1.481
C3H8O(2PRI)	20.000		0.000	0.007	0.000	0.00	-0.04	-0.778	-319.457	60.095	0.775
C4H11O3P	20.000		0.000	0.008	0.000	0.00	0.00	0.000	0.000	138.102	#####
C4H10FO2P(Sg)	20.000		0.000	0.040	0.006	0.00	-0.28	-0.808	-963.965	140.093	0.006
S	20.000		0.000	0.000	0.000	0.00	0.00	-0.113	-0.113	32.065	2.070
Burster M34	20.000		0.033	7.348	0.000	-0.04	0.57				
C3H6N6O6	20.000		0.020	4.409	0.000	-0.02	1.54	-1.245	77.833	222.116	#####
C7H5N3O6(246TNT)	20.000		0.013	2.866	0.000	-0.02	-0.81	-1.223	-64.401	227.131	#####
C16H34(HDA)	20.000		0.000	0.073	0.000	0.00	-0.17	-2.209	-509.709	226.441	#####
Burster M36	20.000		0.006	1.361	0.000	-0.01	0.10				
C3H6N6O6	20.000		0.004	0.816	0.000	0.00	0.29	-1.245	77.833	222.116	#####
C7H5N3O6(246TNT)	20.000		0.002	0.531	0.000	0.00	-0.15	-1.223	-64.401	227.131	#####
C16H34(HDA)	20.000		0.000	0.014	0.000	0.00	-0.03	-2.209	-509.709	226.441	#####
Fuze	25.000		0.028	2.419	0.000	0.00	0.41				
C3H6N6O6	25.000		0.005	1.140	0.000	0.00	0.41	0.000	79.078	222.116	#####
Fe	25.000		0.023	1.279	0.000	0.00	0.00	0.000	0.000	55.845	7.860
Projectile	20.000		0.774	43.300	0.005	-0.10	-0.98				
Fe	20.000		0.771	43.077	0.005	-0.10	-0.10	-0.125	-0.125	55.845	7.860
C4H8O(a)	20.000		0.003	0.223	0.000	-0.01	-0.88	-1.685	-285.695	72.106	#####

Metal dust munition	20.000	0.000	0.000	0.000	0.00	0.00				
Al	20.000	0.000	0.000	0.000	0.00	0.00	-0.121	-0.121	26.982	2.700
Sb	20.000	0.000	0.000	0.000	0.00	0.00	-0.127	-0.127	121.760	6.684
As	20.000	0.000	0.000	0.000	0.00	0.00	-0.123	-0.123	74.922	5.750
Ba	20.000	0.000	0.000	0.000	0.00	0.00	-0.140	-0.140	137.327	3.620
Be	20.000	0.000	0.000	0.000	0.00	0.00	-0.082	-0.082	9.012	1.850
B	20.000	0.000	0.000	0.000	0.00	0.00	-0.056	-0.056	10.811	2.340
Cd	20.000	0.000	0.000	0.000	0.00	0.00	-0.131	-0.131	112.414	8.690
Cr	20.000	0.000	0.000	0.000	0.00	0.00	-0.117	-0.117	51.996	7.190
Co	20.000	0.000	0.000	0.000	0.00	0.00	-0.127	-0.127	58.933	8.860
Cu	20.000	0.000	0.000	0.000	0.00	0.00	-0.122	-0.122	63.546	8.960
Fe	20.000	0.000	0.000	0.000	0.00	0.00	-0.125	-0.125	55.845	7.860
Pb	20.000	0.000	0.000	0.000	0.00	0.00	-0.133	-0.133	207.200	11.344
Mn	20.000	0.000	0.000	0.000	0.00	0.00	-0.131	-0.131	54.938	7.430
Hg	20.000	0.000	0.000	0.000	0.00	0.00	-0.140	-0.140	200.590	13.534
Ni	20.000	0.000	0.000	0.000	0.00	0.00	-0.129	-0.129	58.693	8.900
P	20.000	0.000	0.000	0.000	0.00	0.00	-0.119	-0.119	30.974	1.823
Se	20.000	0.000	0.000	0.000	0.00	0.00	-0.125	-0.125	78.971	4.810
Ag	20.000	0.000	0.000	0.000	0.00	0.00	-0.126	-0.126	107.868	10.500
Th	20.000	0.000	0.000	0.000	0.00	0.00	-0.131	-0.131	232.038	11.700
Sn	20.000	0.000	0.000	0.000	0.00	0.00	-0.135	-0.135	118.710	7.265
V	20.000	0.000	0.000	0.000	0.00	0.00	-0.124	-0.124	50.942	5.960
Zn	20.000	0.000	0.000	0.000	0.00	0.00	-0.127	-0.127	65.380	7.140
Stream 1A SRC container	25.000	1.665	92.996	0.141	0.00	-1.00				
Fe	25.000	1.651	92.220	0.012	0.00	0.00	0.000	0.000	55.845	7.860
C4H9(Bg)	25.000	0.006	0.328	0.129	0.00	0.38	0.000	66.500	57.114	0.003
C12H22O11(SUC)	25.000	0.000	0.108	0.000	0.00	-0.70	0.000	-2221.700	342.296	#####
C3H6(PPE)	25.000	0.008	0.340	0.000	0.00	-0.68	0.000	-84.471	42.080	0.910
PP Tray	20.000	0.179	7.535	0.008	-0.06	-15.19				
C3H6(PPE)	20.000	0.179	7.535	0.008	-0.06	-15.19	-0.336	-84.806	42.080	0.910
Stream 3 Combustion air	500.000	9.369	270.308	210.000	134.52	134.52				
N2(g)	500.000	7.402	207.348	165.900	105.14	105.14	14.204	14.204	28.013	0.001
O2(g)	500.000	1.968	62.959	44.100	29.38	29.38	14.934	14.934	31.999	0.001

OUTPUT SPECIES (1) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 4 Outlet SDC	550.000		10.200	292.885	224.681	169.11	-192.87				
N2(g)	550.000		7.494	209.938	167.972	118.23	118.23	15.776	15.776	28.013	0.001
O2(g)	550.000		1.247	39.890	27.941	20.72	20.72	16.620	16.620	31.999	0.001
CO2(g)	550.000		0.548	24.111	12.280	13.15	-202.44	24.006	-369.499	44.010	0.002
CO(g)	550.000		0.017	0.472	0.378	0.27	-1.59	15.943	-94.598	28.010	0.001
CH4(g)	550.000		0.067	1.082	1.511	1.78	-3.25	26.401	-48.199	16.042	0.001
NO(g)	550.000		0.033	0.976	0.729	0.53	3.47	16.310	106.610	30.006	0.001
HCl(g)	550.000		0.000	0.001	0.001	0.00	0.00	15.545	-76.767	36.461	0.002
SO2(g)	550.000		0.000	0.000	0.000	0.00	0.00	25.233	-271.580	64.064	0.003
P3O6(g)	550.000		0.002	0.425	0.050	0.21	-3.33	93.421	-1482.260	188.918	0.008
P4O10(g)	550.000		0.001	0.205	0.016	0.10	-2.00	136.082	-2768.032	283.889	0.013
H2O(g)	550.000		0.565	10.175	12.659	10.69	-125.90	18.925	-222.901	18.015	0.001
H2S(g)	550.000		0.000	0.000	0.000	0.00	0.00	20.188	-0.314	34.081	0.002
CS2(g)	550.000		0.000	0.000	0.000	0.00	0.00	27.779	144.479	76.141	0.003
C2H4(g)	550.000		0.042	1.182	0.945	1.47	3.68	34.816	87.216	28.053	0.001
C	550.000		0.126	1.519	0.001	1.02	1.02	8.100	8.100	12.011	2.260
HF(g)	550.000		0.009	0.177	0.198	0.14	-2.28	15.362	-257.938	20.006	0.001
Fe	550.000		0.049	2.732	0.000	0.81	0.81	16.507	16.507	55.845	7.860
Stream 12 Scrap	550.000		2.397	133.844	0.017	39.56	39.56				
Fe	550.000		2.397	133.844	0.017	39.56	39.56	16.507	16.507	55.845	7.860
S	550.000		0.000	0.000	0.000	0.00	0.00	19.489	19.489	32.065	2.070
Heat Loss:						200.00	200.00				

INPUT SPECIES (2) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 4 Inlet Buffer Tank											
N2(g)	350.000		7.494	209.938	167.972	71.89	71.89	9.593	9.593	28.013	0.001
O2(g)	350.000		1.247	39.890	27.941	12.45	12.45	9.990	9.990	31.999	0.001
CO2(g)	350.000		0.548	24.111	12.280	7.68	-207.91	14.015	-379.490	44.010	0.002
CO(g)	350.000		0.017	0.472	0.378	0.16	-1.70	9.675	-100.866	28.010	0.001
CH4(g)	350.000		0.067	1.082	1.511	0.97	-4.06	14.437	-60.163	16.042	0.001
NO(g)	350.000		0.033	0.976	0.729	0.32	3.26	9.873	100.173	30.006	0.001
HCl(g)	350.000		0.000	0.001	0.001	0.00	0.00	9.520	-82.792	36.461	0.002
SO2(g)	350.000		0.000	0.000	0.000	0.00	0.00	14.783	-282.030	64.064	0.003
P3O6(g)	350.000		0.002	0.425	0.050	0.12	-3.42	54.403	-1521.278	188.918	0.008
P4O10(g)	350.000		0.001	0.205	0.016	0.06	-2.04	78.548	-2825.566	283.889	0.013
H2O(g)	350.000		0.565	10.175	12.659	6.41	-130.17	11.351	-230.475	18.015	0.001
H2S(g)	350.000		0.000	0.000	0.000	0.00	0.00	11.926	-8.576	34.081	0.002
CS2(g)	350.000		0.000	0.000	0.000	0.00	0.00	16.543	133.243	76.141	0.003
C2H4(g)	350.000		0.042	1.182	0.945	0.80	3.01	18.992	71.392	28.053	0.001
C	350.000		0.126	1.519	0.001	0.55	0.55	4.338	4.338	12.011	2.260
HF(g)	350.000		0.009	0.177	0.198	0.08	-2.33	9.478	-263.822	20.006	0.001
Fe	350.000		0.049	2.732	0.000	0.45	0.45	9.278	9.278	55.845	7.860

OUTPUT SPECIES (2) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 5 Outlet Buffer											
Tank	350.000		10.175	291.519	224.681	101.73	-260.25				
N2(g)	350.000		7.494	209.938	167.972	71.89	71.89	9.593	9.593	28.013	0.001
O2(g)	350.000		1.247	39.890	27.941	12.45	12.45	9.990	9.990	31.999	0.001
CO2(g)	350.000		0.548	24.111	12.280	7.68	-207.91	14.015	-379.490	44.010	0.002
CO(g)	350.000		0.017	0.472	0.378	0.16	-1.70	9.675	-100.866	28.010	0.001
CH4(g)	350.000		0.067	1.082	1.511	0.97	-4.06	14.437	-60.163	16.042	0.001
NO(g)	350.000		0.033	0.976	0.729	0.32	3.26	9.873	100.173	30.006	0.001
HCl(g)	350.000		0.000	0.001	0.001	0.00	0.00	9.520	-82.792	36.461	0.002
SO2(g)	350.000		0.000	0.000	0.000	0.00	0.00	14.783	-282.030	64.064	0.003
P3O6(g)	350.000		0.002	0.425	0.050	0.12	-3.42	54.403	-1521.278	188.918	0.008
P4O10(g)	350.000		0.001	0.205	0.016	0.06	-2.04	78.548	-2825.566	283.889	0.013
H2O(g)	350.000		0.565	10.175	12.659	6.41	-130.17	11.351	-230.475	18.015	0.001
H2S(g)	350.000		0.000	0.000	0.000	0.00	0.00	11.926	-8.576	34.081	0.002
CS2(g)	350.000		0.000	0.000	0.000	0.00	0.00	16.543	133.243	76.141	0.003
C2H4(g)	350.000		0.042	1.182	0.945	0.80	3.01	18.992	71.392	28.053	0.001
C	350.000		0.126	1.519	0.001	0.55	0.55	4.338	4.338	12.011	2.260
HF(g)	350.000		0.009	0.177	0.198	0.08	-2.33	9.478	-263.822	20.006	0.001
Fe	350.000		0.024	1.366	0.000	0.23	0.23	9.278	9.278	55.845	7.860
Stream 6 Dust Buffer											
Tank	350.000		0.024	1.366	0.000	0.23	0.23				
Fe	350.000		0.024	1.366	0.000	0.23	0.23	9.278	9.278	55.845	7.860

INPUT SPECIES (3) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 50 Inlet THO	350.000		10.175	291.519	224.681	101.73	-260.25				
N2(g)	350.000		7.494	209.938	167.972	71.89	71.89	9.593	9.593	28.013	0.001
O2(g)	350.000		1.247	39.890	27.941	12.45	12.45	9.990	9.990	31.999	0.001
CO2(g)	350.000		0.548	24.111	12.280	7.68	-207.91	14.015	-379.490	44.010	0.002
CO(g)	350.000		0.017	0.472	0.378	0.16	-1.70	9.675	-100.866	28.010	0.001
CH4(g)	350.000		0.067	1.082	1.511	0.97	-4.06	14.437	-60.163	16.042	0.001
NO(g)	350.000		0.033	0.976	0.729	0.32	3.26	9.873	100.173	30.006	0.001
HCl(g)	350.000		0.000	0.001	0.001	0.00	0.00	9.520	-82.792	36.461	0.002
SO2(g)	350.000		0.000	0.000	0.000	0.00	0.00	14.783	-282.030	64.064	0.003
P3O6(g)	350.000		0.002	0.425	0.050	0.12	-3.42	54.403	-1521.278	188.918	0.008
P4O10(g)	350.000		0.001	0.205	0.016	0.06	-2.04	78.548	-2825.566	283.889	0.013
H2O(g)	350.000		0.565	10.175	12.659	6.41	-130.17	11.351	-230.475	18.015	0.001
H2S(g)	350.000		0.000	0.000	0.000	0.00	0.00	11.926	-8.576	34.081	0.002
CS2(g)	350.000		0.000	0.000	0.000	0.00	0.00	16.543	133.243	76.141	0.003
C2H4(g)	350.000		0.042	1.182	0.945	0.80	3.01	18.992	71.392	28.053	0.001
C	350.000		0.126	1.519	0.001	0.55	0.55	4.338	4.338	12.011	2.260
HF(g)	350.000		0.009	0.177	0.198	0.08	-2.33	9.478	-263.822	20.006	0.001
Fe	350.000		0.024	1.366	0.000	0.23	0.23	9.278	9.278	55.845	7.860
Stream 71 Primary air	20.000		40.154	1158.462	900.000	-5.86	-5.86				
N2(g)	20.000		31.722	888.636	711.000	-4.62	-4.62	-0.146	-0.146	28.013	0.001
O2(g)	20.000		8.432	269.826	189.000	-1.24	-1.24	-0.147	-0.147	31.999	0.001
Stream 72 Secondary air + Cooling air	200.000		13.385	386.154	300.000	68.88	68.88				
N2(g)	200.000		10.574	296.212	237.000	54.12	54.12	5.118	5.118	28.013	0.001
O2(g)	200.000		2.811	89.942	63.000	14.77	14.77	5.254	5.254	31.999	0.001
Stream 66 Natural gas	20.000		2.677	46.424	60.000	-0.48	-191.41				
CH4(g)	20.000		2.409	38.650	54.000	-0.43	-180.16	-0.178	-74.778	16.042	0.001
C2H6(g)	20.000		0.134	4.025	3.000	-0.03	-11.24	-0.261	-83.941	30.069	0.001
N2(g)	20.000		0.134	3.750	3.000	-0.02	-0.02	-0.146	-0.146	28.013	0.001

OUTPUT SPECIES (3) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 51 Outlet THO	1108.100		66.291	1882.559	1485.545	2411.90	-438.70				
N2(g)	1108.100		49.910	1398.135	1118.652	1711.37	1711.37	34.289	34.289	28.013	0.001
O2(g)	1108.100		6.773	216.729	151.808	245.78	245.78	36.287	36.287	31.999	0.001
CO2(g)	1108.100		3.518	154.846	78.862	192.96	-1191.58	54.842	-338.663	44.010	0.002
CO(g)	1108.100		0.001	0.038	0.030	0.05	-0.10	34.666	-75.875	28.010	0.001
CH4(g)	1108.100		0.000	0.000	0.000	0.00	0.00	69.651	-4.949	16.042	0.001
NO(g)	1108.100		0.061	1.833	1.369	2.17	7.68	35.503	125.803	30.006	0.001
HCl(g)	1108.100		0.000	0.001	0.001	0.00	0.00	33.512	-58.799	36.461	0.002
SO2(g)	1108.100		0.000	0.000	0.000	0.00	0.00	56.484	-240.329	64.064	0.003
P3O6(g)	1108.100		0.000	0.000	0.000	0.00	0.00	209.399	-1366.282	188.918	0.008
P4O10(g)	1108.100		0.002	0.684	0.054	0.74	-6.25	308.988	-2595.126	283.889	0.013
H2O(g)	1108.100		6.004	108.164	134.571	256.66	-1195.26	42.748	-199.078	18.015	0.001
H2S(g)	1108.100		0.000	0.000	0.000	0.00	0.00	46.564	26.062	34.081	0.002
CS2(g)	1108.100		0.000	0.000	0.000	0.00	0.00	60.945	177.645	76.141	0.003
C2H4(g)	1108.100		0.000	0.000	0.000	0.00	0.00	89.215	141.615	28.053	0.001
C	1108.100		0.000	0.000	0.000	0.00	0.00	20.437	20.437	12.011	2.260
HF(g)	1108.100		0.009	0.177	0.198	0.29	-2.13	32.453	-240.847	20.006	0.001
Fe	1108.100		0.000	0.000	0.000	0.00	0.00	41.439	41.439	55.845	7.860
Fe2O3	1108.100		0.012	1.953	0.000	1.88	-8.20	153.838	-670.944	159.688	5.240
Heat Loss:						50.00	50.00				

INPUT SPECIES (4) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 51 Inlet Quench	1108.100		66.291	1882.559	1485.545	2411.90	-438.70				
N2(g)	1108.100		49.910	1398.135	1118.652	1711.37	1711.37	34.289	34.289	28.013	0.001
O2(g)	1108.100		6.773	216.729	151.808	245.78	245.78	36.287	36.287	31.999	0.001
CO2(g)	1108.100		3.518	154.846	78.862	192.96	-1191.58	54.842	-338.663	44.010	0.002
CO(g)	1108.100		0.001	0.038	0.030	0.05	-0.10	34.666	-75.875	28.010	0.001
CH4(g)	1108.100		0.000	0.000	0.000	0.00	0.00	69.651	-4.949	16.042	0.001
NO(g)	1108.100		0.061	1.833	1.369	2.17	7.68	35.503	125.803	30.006	0.001
HCl(g)	1108.100		0.000	0.001	0.001	0.00	0.00	33.512	-58.799	36.461	0.002
SO2(g)	1108.100		0.000	0.000	0.000	0.00	0.00	56.484	-240.329	64.064	0.003
P3O6(g)	1108.100		0.000	0.000	0.000	0.00	0.00	209.399	-1366.282	188.918	0.008
P4O10(g)	1108.100		0.002	0.684	0.054	0.74	-6.25	308.988	-2595.126	283.889	0.013
H2O(g)	1108.100		6.004	108.164	134.571	256.66	-1195.26	42.748	-199.078	18.015	0.001
H2S(g)	1108.100		0.000	0.000	0.000	0.00	0.00	46.564	26.062	34.081	0.002
CS2(g)	1108.100		0.000	0.000	0.000	0.00	0.00	60.945	177.645	76.141	0.003
C2H4(g)	1108.100		0.000	0.000	0.000	0.00	0.00	89.215	141.615	28.053	0.001
C	1108.100		0.000	0.000	0.000	0.00	0.00	20.437	20.437	12.011	2.260
HF(g)	1108.100		0.009	0.177	0.198	0.29	-2.13	32.453	-240.847	20.006	0.001
Fe2O3	1108.100		0.012	1.953	0.000	1.88	-8.20	153.838	-670.944	159.688	5.240
Stream 85 Quench											
Water	78.804		1110.169	20000.000	20.060	4505.86	-312813.66				
H2O(l)	78.804		1110.169	20000.000	20.060	4505.86	-312813.66	4.059	-281.771	18.015	0.997

OUTPUT SPECIES (4) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 52 Quench outlet	80.000		118.356	2818.652	2652.770	206.32	-15226.02				
N2(g)	80.000		49.910	1398.135	1118.652	80.00	80.00	1.603	1.603	28.013	0.001
O2(g)	80.000		6.773	216.729	151.808	11.00	11.00	1.624	1.624	31.999	0.001
CO2(g)	80.000		3.518	154.846	78.862	7.43	-1377.11	2.112	-391.393	44.010	0.002
CO(g)	80.000		0.001	0.038	0.030	0.00	-0.15	1.606	-108.936	28.010	0.001
CH4(g)	80.000		0.000	0.000	0.000	0.00	0.00	2.026	-72.574	16.042	0.001
NO(g)	80.000		0.061	1.833	1.369	0.10	5.62	1.639	91.939	30.006	0.001
HCl(g)	80.000		0.000	0.001	0.001	0.00	0.00	1.602	-90.710	36.461	0.002
SO2(g)	80.000		0.000	0.000	0.000	0.00	0.00	2.255	-294.558	64.064	0.003
P3O6(g)	80.000		0.000	0.000	0.000	0.00	0.00	7.870	-1567.811	188.918	0.008
P4O10(g)	80.000		0.002	0.479	0.038	0.02	-4.88	11.161	-2892.953	283.889	0.013
H2O(g)	80.000		58.084	1046.400	1301.872	107.75	-13938.47	1.855	-239.971	18.015	0.001
H2S(g)	80.000		0.000	0.000	0.000	0.00	0.00	1.901	-18.601	34.081	0.002
CS2(g)	80.000		0.000	0.000	0.000	0.00	0.00	2.571	119.271	76.141	0.003
C2H4(g)	80.000		0.000	0.000	0.000	0.00	0.00	2.511	54.911	28.053	0.001
C	80.000		0.000	0.000	0.000	0.00	0.00	0.519	0.519	12.011	2.260
HF(g)	80.000		0.006	0.124	0.139	0.01	-1.68	1.603	-271.697	20.006	0.001
Fe2O3	80.000		0.000	0.068	0.000	0.00	-0.35	6.023	-818.759	159.688	5.240
Scrubber liquid	80.000		1058.102	19063.907	19.119	4390.28	-298056.33				
H2O(l)	80.000		1058.084	19061.686	19.119	4390.21	-298042.04	4.149	-281.681	18.015	0.997
H3PO4(a)	80.000		0.003	0.283	0.000	0.02	-3.73	5.431	-1288.689	97.995	#####
HF(ia)	80.000		0.003	0.053	0.000	-0.02	-0.90	-5.868	-338.498	20.006	0.987
Fe2O3	80.000		0.012	1.884	0.000	0.07	-9.66	6.023	-818.759	159.688	5.240
Heat Loss:						30.00	30.00				

INPUT SPECIES (5) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l	
Stream 52 Inlet NSC	80.000		118.356	2818.652	2652.770	206.32	-15226.02					
N2(g)	80.000		49.910	1398.135	1118.652	80.00	80.00	1.603	1.603	28.013	0.001	
O2(g)	80.000			6.773	216.729	151.808	11.00	11.00	1.624	1.624	31.999	0.001
CO2(g)	80.000			3.518	154.846	78.862	7.43	-1377.11	2.112	-391.393	44.010	0.002
CO(g)	80.000			0.001	0.038	0.030	0.00	-0.15	1.606	-108.936	28.010	0.001
CH4(g)	80.000			0.000	0.000	0.000	0.00	0.00	2.026	-72.574	16.042	0.001
NO(g)	80.000			0.061	1.833	1.369	0.10	5.62	1.639	91.939	30.006	0.001
HCl(g)	80.000			0.000	0.001	0.001	0.00	0.00	1.602	-90.710	36.461	0.002
SO2(g)	80.000			0.000	0.000	0.000	0.00	0.00	2.255	-294.558	64.064	0.003
P3O6(g)	80.000			0.000	0.000	0.000	0.00	0.00	7.870	-1567.811	188.918	0.008
P4O10(g)	80.000			0.002	0.479	0.038	0.02	-4.88	11.161	-2892.953	283.889	0.013
H2O(g)	80.000		58.084	1046.400	1301.872	107.75	-13938.47	1.855	-239.971	18.015	0.001	
H2S(g)	80.000			0.000	0.000	0.000	0.00	0.00	1.901	-18.601	34.081	0.002
CS2(g)	80.000			0.000	0.000	0.000	0.00	0.00	2.571	119.271	76.141	0.003
C2H4(g)	80.000			0.000	0.000	0.000	0.00	0.00	2.511	54.911	28.053	0.001
C	80.000			0.000	0.000	0.000	0.00	0.00	0.519	0.519	12.011	2.260
HF(g)	80.000			0.006	0.124	0.139	0.01	-1.68	1.603	-271.697	20.006	0.001
Fe2O3	80.000			0.000	0.068	0.000	0.00	-0.35	6.023	-818.759	159.688	5.240
Stream 87 Scrubbing liquid	79.000		832.627	15000.000	15.045	3391.74	-234597.90					
H2O(l)	79.000		832.627	15000.000	15.045	3391.74	-234597.90	4.074	-281.756	18.015	0.997	
Stream 102 Dosing KOP 2	25.000		0.217	4.902	0.003	0.00	-67.63					
KOH(a)	25.000		0.026	1.471	0.000	0.00	-13.18	0.000	-502.917	56.106 #####		
H2O(l)	25.000		0.190	3.431	0.003	0.00	-54.44	0.000	-285.830	18.015	0.997	

OUTPUT SPECIES (5) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 53 Outlet NSC	79.770		116.518	2785.087	2611.577	202.04	-14781.21				
N2(g)	79.770		49.910	1398.135	1118.652	79.67	79.67	1.596	1.596	28.013	0.001
O2(g)	79.770		6.773	216.729	151.808	10.95	10.95	1.617	1.617	31.999	0.001
CO2(g)	79.770		3.518	154.846	78.862	7.40	-1377.14	2.103	-391.402	44.010	0.002
CO(g)	79.770		0.001	0.038	0.030	0.00	-0.15	1.599	-108.942	28.010	0.001
CH4(g)	79.770		0.000	0.000	0.000	0.00	0.00	2.017	-72.583	16.042	0.001
NO(g)	79.770		0.061	1.833	1.369	0.10	5.62	1.632	91.932	30.006	0.001
HCl(g)	79.770		0.000	0.001	0.001	0.00	0.00	1.595	-90.716	36.461	0.002
SO2(g)	79.770		0.000	0.000	0.000	0.00	0.00	2.246	-294.567	64.064	0.003
P3O6(g)	79.770		0.000	0.000	0.000	0.00	0.00	7.835	-1567.846	188.918	0.008
P4O10(g)	79.770		0.000	0.005	0.000	0.00	-0.05	11.112	-2893.002	283.889	0.013
H2O(g)	79.770		56.254	1013.432	1260.855	103.92	-13499.76	1.847	-239.979	18.015	0.001
H2S(g)	79.770		0.000	0.000	0.000	0.00	0.00	1.893	-18.609	34.081	0.002
CS2(g)	79.770		0.000	0.000	0.000	0.00	0.00	2.560	119.260	76.141	0.003
C2H4(g)	79.770		0.000	0.000	0.000	0.00	0.00	2.500	54.900	28.053	0.001
C	79.770		0.000	0.000	0.000	0.00	0.00	0.517	0.517	12.011	2.260
HF(g)	79.770		0.000	0.000	0.000	0.00	0.00	1.596	-271.704	20.006	0.001
Fe2O3	79.770		0.000	0.068	0.000	0.00	-0.35	5.997	-818.785	159.688	5.240
Scrubbing liquid	79.770		834.676	15038.468	15.082	3448.64	-235140.35				
H2O(l)	79.770		834.663	15036.691	15.082	3448.67	-235123.12	4.132	-281.698	18.015	0.997
K3PO4(ia)	79.770		0.007	1.417	0.000	0.00	-13.59	0.000	-2034.930	212.266 #####	
KF(ia)	79.770		0.006	0.359	0.000	-0.03	-3.64	-4.650	-589.740	58.097 #####	
Heat Loss:						30.00	30.00				

INPUT SPECIES (6) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 53 Inlet Wet ESP	79.770		116.518	2785.087	2611.577	202.15	-14781.10				
N2(g)	79.770		49.910	1398.135	1118.652	79.71	79.71	1.597	1.597	28.013	0.001
O2(g)	79.770		6.773	216.729	151.808	10.96	10.96	1.618	1.618	31.999	0.001
CO2(g)	79.770		3.518	154.846	78.862	7.40	-1377.13	2.104	-391.401	44.010	0.002
CO(g)	79.770		0.001	0.038	0.030	0.00	-0.15	1.600	-108.942	28.010	0.001
CH4(g)	79.770		0.000	0.000	0.000	0.00	0.00	2.018	-72.582	16.042	0.001
NO(g)	79.770		0.061	1.833	1.369	0.10	5.62	1.633	91.933	30.006	0.001
HCl(g)	79.770		0.000	0.001	0.001	0.00	0.00	1.596	-90.716	36.461	0.002
SO2(g)	79.770		0.000	0.000	0.000	0.00	0.00	2.247	-294.566	64.064	0.003
P3O6(g)	79.770		0.000	0.000	0.000	0.00	0.00	7.840	-1567.841	188.918	0.008
P4O10(g)	79.770		0.000	0.005	0.000	0.00	-0.05	11.118	-2892.996	283.889	0.013
H2O(g)	79.770		56.254	1013.432	1260.855	103.97	-13499.71	1.848	-239.978	18.015	0.001
H2S(g)	79.770		0.000	0.000	0.000	0.00	0.00	1.894	-18.608	34.081	0.002
C	79.770		0.000	0.000	0.000	0.00	0.00	0.517	0.517	12.011	2.260
HF(g)	79.770		0.000	0.000	0.000	0.00	0.00	1.597	-271.703	20.006	0.001
Fe2O3	79.770		0.000	0.068	0.000	0.00	-0.35	6.000	-818.782	159.688	5.240
Stream 94 Mist water	77.000		133.220	2400.000	2.407	522.52	-37555.82				
H2O(l)	77.000		133.220	2400.000	2.407	522.52	-37555.82	3.922	-281.908	18.015	0.997

OUTPUT SPECIES (6) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 54 Outlet Wet ESP											
N2(g)	79.670		49.910	1398.135	1118.652	79.52	79.52	1.593	1.593	28.013	0.001
O2(g)	79.670		6.773	216.729	151.808	10.93	10.93	1.614	1.614	31.999	0.001
CO2(g)	79.670		3.518	154.846	78.862	7.39	-1377.15	2.099	-391.406	44.010	0.002
CO(g)	79.670		0.001	0.038	0.030	0.00	-0.15	1.596	-108.945	28.010	0.001
CH4(g)	79.670		0.000	0.000	0.000	0.00	0.00	2.013	-72.587	16.042	0.001
NO(g)	79.670		0.061	1.833	1.369	0.10	5.62	1.629	91.929	30.006	0.001
HCl(g)	79.670		0.000	0.001	0.001	0.00	0.00	1.592	-90.719	36.461	0.002
SO2(g)	79.670		0.000	0.000	0.000	0.00	0.00	2.241	-294.572	64.064	0.003
P3O6(g)	79.670		0.000	0.000	0.000	0.00	0.00	7.820	-1567.861	188.918	0.008
P4O10(g)	79.670		0.000	0.000	0.000	0.00	0.00	11.090	-2893.024	283.889	0.013
H2O(g)	79.670		54.904	989.111	1230.596	101.24	-13175.98	1.844	-239.982	18.015	0.001
H2S(g)	79.670		0.000	0.000	0.000	0.00	0.00	1.889	-18.612	34.081	0.002
C	79.670		0.000	0.000	0.000	0.00	0.00	0.516	0.516	12.011	2.260
HF(g)	79.670		0.000	0.000	0.000	0.00	0.00	1.593	-271.707	20.006	0.001
Fe2O3	79.670		0.000	0.000	0.000	0.00	0.00	5.986	-818.796	159.688	5.240
Stream 97 Mist water return											
P3O6(g)	79.670		0.000	0.000	0.000	0.00	0.00	7.820	-1567.861	188.918	0.008
P4O10(g)	79.670		0.000	0.005	0.000	0.00	-0.05	11.090	-2893.024	283.889	0.013
Fe2O3	79.670		0.000	0.068	0.000	0.00	-0.35	5.986	-818.796	159.688	5.240
C	79.670		0.000	0.000	0.000	0.00	0.00	0.516	0.516	12.011	2.260
H2O(l)	79.670		134.570	2424.321	2.432	555.00	-37909.21	4.124	-281.706	18.015	0.997
Heat Loss:						30.00	30.00				

INPUT SPECIES (7) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 54 Inlet HEX	79.750		115.167	2760.693	2581.318	199.47	-14456.92				
N2(g)	79.750		49.910	1398.135	1118.652	79.64	79.64	1.596	1.596	28.013	0.001
O2(g)	79.750		6.773	216.729	151.808	10.95	10.95	1.617	1.617	31.999	0.001
CO2(g)	79.750		3.518	154.846	78.862	7.40	-1377.14	2.102	-391.403	44.010	0.002
CO(g)	79.750		0.001	0.038	0.030	0.00	-0.15	1.598	-108.943	28.010	0.001
CH4(g)	79.750		0.000	0.000	0.000	0.00	0.00	2.016	-72.584	16.042	0.001
NO(g)	79.750		0.061	1.833	1.369	0.10	5.62	1.631	91.931	30.006	0.001
HCl(g)	79.750		0.000	0.001	0.001	0.00	0.00	1.595	-90.717	36.461	0.002
SO2(g)	79.750		0.000	0.000	0.000	0.00	0.00	2.245	-294.568	64.064	0.003
P3O6(g)	79.750		0.000	0.000	0.000	0.00	0.00	7.832	-1567.849	188.918	0.008
P4O10(g)	79.750		0.000	0.000	0.000	0.00	0.00	11.107	-2893.007	283.889	0.013
H2O(g)	79.750		54.904	989.111	1230.596	101.39	-13175.83	1.847	-239.979	18.015	0.001
H2S(g)	79.750		0.000	0.000	0.000	0.00	0.00	1.892	-18.610	34.081	0.002
HF(g)	79.750		0.000	0.000	0.000	0.00	0.00	1.595	-271.705	20.006	0.001
Fe2O3	79.750		0.000	0.000	0.000	0.00	0.00	5.995	-818.787	159.688	5.240
Stream 110 Cooling											
water	10.000		4233.156	90000.000	89.642	-5254.75	-1264977.64				
H2O(l)	10.000		3996.607	72000.000	72.217	-4504.10	-1146854.38	-1.127	-286.957	18.015	0.997
C3H8O2(PGLI)	10.000		236.548	18000.000	17.425	-750.65	-118123.26	-3.173	-499.362	76.094	1.033

OUTPUT SPECIES (7) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 55 Outet HEX	45.000		74.891	2035.110	1678.588	45.59	-4871.01				
N2(g)	45.000		49.910	1398.135	1118.652	29.08	29.08	0.583	0.583	28.013	0.001
O2(g)	45.000		6.773	216.729	151.808	3.99	3.99	0.588	0.588	31.999	0.001
CO2(g)	45.000		3.518	154.846	78.862	2.65	-1381.89	0.752	-392.753	44.010	0.002
CO(g)	45.000		0.001	0.038	0.030	0.00	-0.15	0.583	-109.958	28.010	0.001
CH4(g)	45.000		0.000	0.000	0.000	0.00	0.00	0.721	-73.879	16.042	0.001
NO(g)	45.000		0.061	1.833	1.369	0.04	5.55	0.597	90.897	30.006	0.001
HCl(g)	45.000		0.000	0.001	0.001	0.00	0.00	0.583	-91.729	36.461	0.002
SO2(g)	45.000		0.000	0.000	0.000	0.00	0.00	0.808	-296.005	64.064	0.003
P4O10(g)	45.000		0.000	0.000	0.000	0.00	0.00	3.914	-2900.200	283.889	0.013
H2O(g)	45.000		14.628	263.528	327.866	9.84	-3527.59	0.673	-241.153	18.015	0.001
HF(g)	45.000		0.000	0.000	0.000	0.00	0.00	0.583	-272.717	20.006	0.001
Fe2O3	45.000		0.000	0.000	0.000	0.00	0.00	2.121	-822.661	159.688	5.240
Stream 89 Condensate	40.000		40.276	725.583	0.728	45.49	-11466.60				
H2O(l)	40.000		40.276	725.583	0.728	45.49	-11466.60	1.129	-284.701	18.015	0.997
Stream 111 Cooling water	15.370		4233.156	90000.000	89.642	-3375.80	-1263098.69				
H2O(l)	15.370		3996.607	72000.000	72.217	-2893.12	-1145243.40	-0.724	-286.554	18.015	0.997
C3H8O2(PGLI)	15.370		236.548	18000.000	17.425	-482.68	-117855.29	-2.041	-498.229	76.094	1.033

INPUT SPECIES (8) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 56 Inlet AHT	45.000		74.891	2035.110	1678.588	45.59	-4871.01				
N2(g)	45.000		49.910	1398.135	1118.652	29.08	29.08	0.583	0.583	28.013	0.001
O2(g)	45.000		6.773	216.729	151.808	3.99	3.99	0.588	0.588	31.999	0.001
CO2(g)	45.000		3.518	154.846	78.862	2.65	-1381.89	0.752	-392.753	44.010	0.002
CO(g)	45.000		0.001	0.038	0.030	0.00	-0.15	0.583	-109.958	28.010	0.001
CH4(g)	45.000		0.000	0.000	0.000	0.00	0.00	0.721	-73.879	16.042	0.001
NO(g)	45.000		0.061	1.833	1.369	0.04	5.55	0.597	90.897	30.006	0.001
HCl(g)	45.000		0.000	0.001	0.001	0.00	0.00	0.583	-91.729	36.461	0.002
SO2(g)	45.000		0.000	0.000	0.000	0.00	0.00	0.808	-296.005	64.064	0.003
P4O10(g)	45.000		0.000	0.000	0.000	0.00	0.00	3.914	-2900.200	283.889	0.013
H2O(g)	45.000		14.628	263.528	327.866	9.84	-3527.59	0.673	-241.153	18.015	0.001
HF(g)	45.000		0.000	0.000	0.000	0.00	0.00	0.583	-272.717	20.006	0.001
Fe2O3	45.000		0.000	0.000	0.000	0.00	0.00	2.121	-822.661	159.688	5.240
Extra Heat:						34.28	34.28				

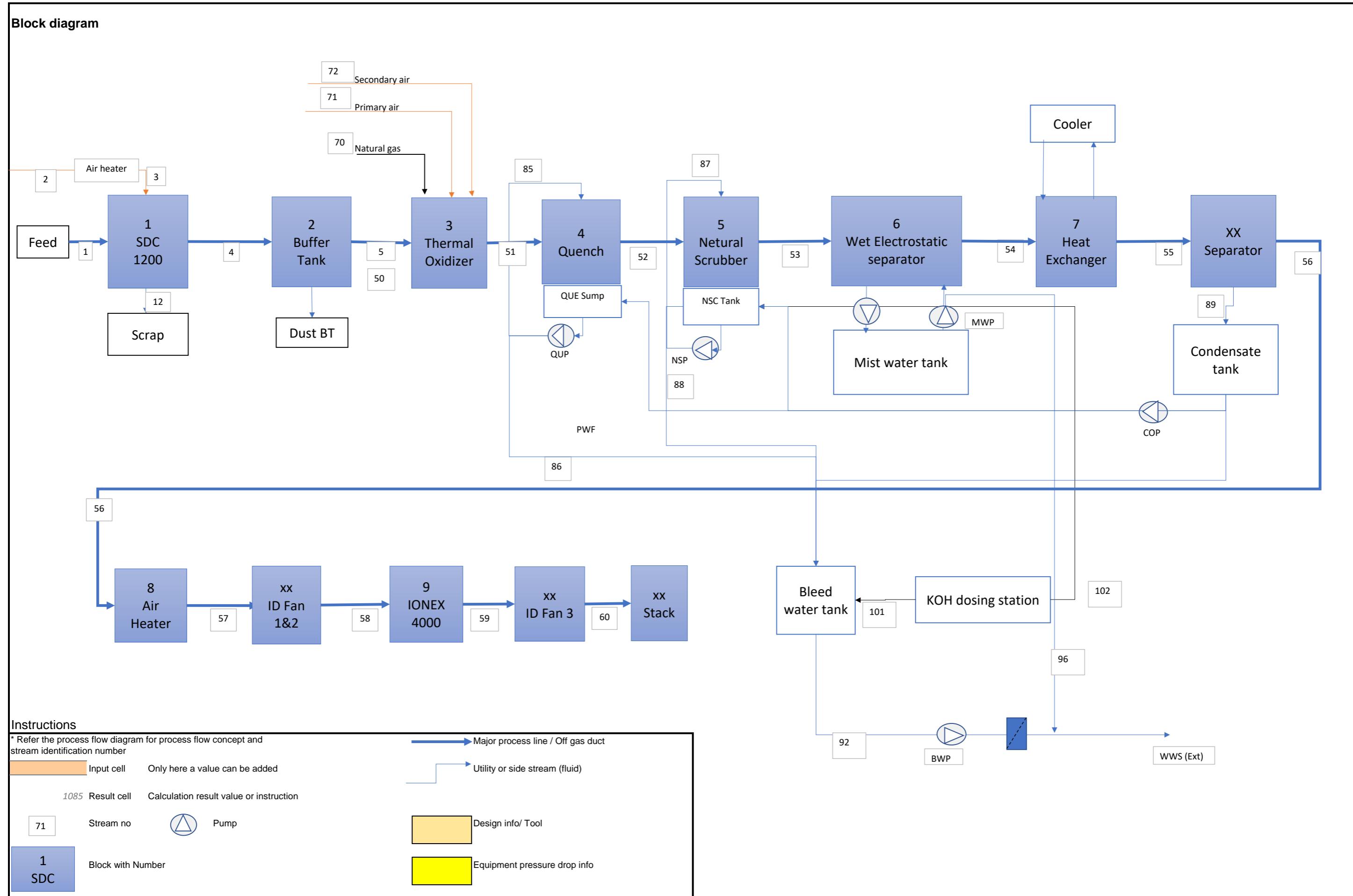
OUTPUT SPECIES (8) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 57 Outlet AHT	60.000		74.891	2035.110	1678.588	79.86	-4836.74				
N2(g)	60.000		49.910	1398.135	1118.652	50.90	50.90	1.020	1.020	28.013	0.001
O2(g)	60.000		6.773	216.729	151.808	6.98	6.98	1.031	1.031	31.999	0.001
CO2(g)	60.000		3.518	154.846	78.862	4.67	-1379.86	1.328	-392.177	44.010	0.002
CO(g)	60.000		0.001	0.038	0.030	0.00	-0.15	1.021	-109.521	28.010	0.001
CH4(g)	60.000		0.000	0.000	0.000	0.00	0.00	1.273	-73.327	16.042	0.001
NO(g)	60.000		0.061	1.833	1.369	0.06	5.58	1.043	91.343	30.006	0.001
HCl(g)	60.000		0.000	0.001	0.001	0.00	0.00	1.019	-91.292	36.461	0.002
SO2(g)	60.000		0.000	0.000	0.000	0.00	0.00	1.423	-295.390	64.064	0.003
P4O10(g)	60.000		0.000	0.000	0.000	0.00	0.00	6.961	-2897.153	283.889	0.013
H2O(g)	60.000		14.628	263.528	327.866	17.24	-3520.19	1.179	-240.647	18.015	0.001
HF(g)	60.000		0.000	0.000	0.000	0.00	0.00	1.020	-272.280	20.006	0.001
Fe2O3	60.000		0.000	0.000	0.000	0.00	0.00	3.767	-821.015	159.688	5.240

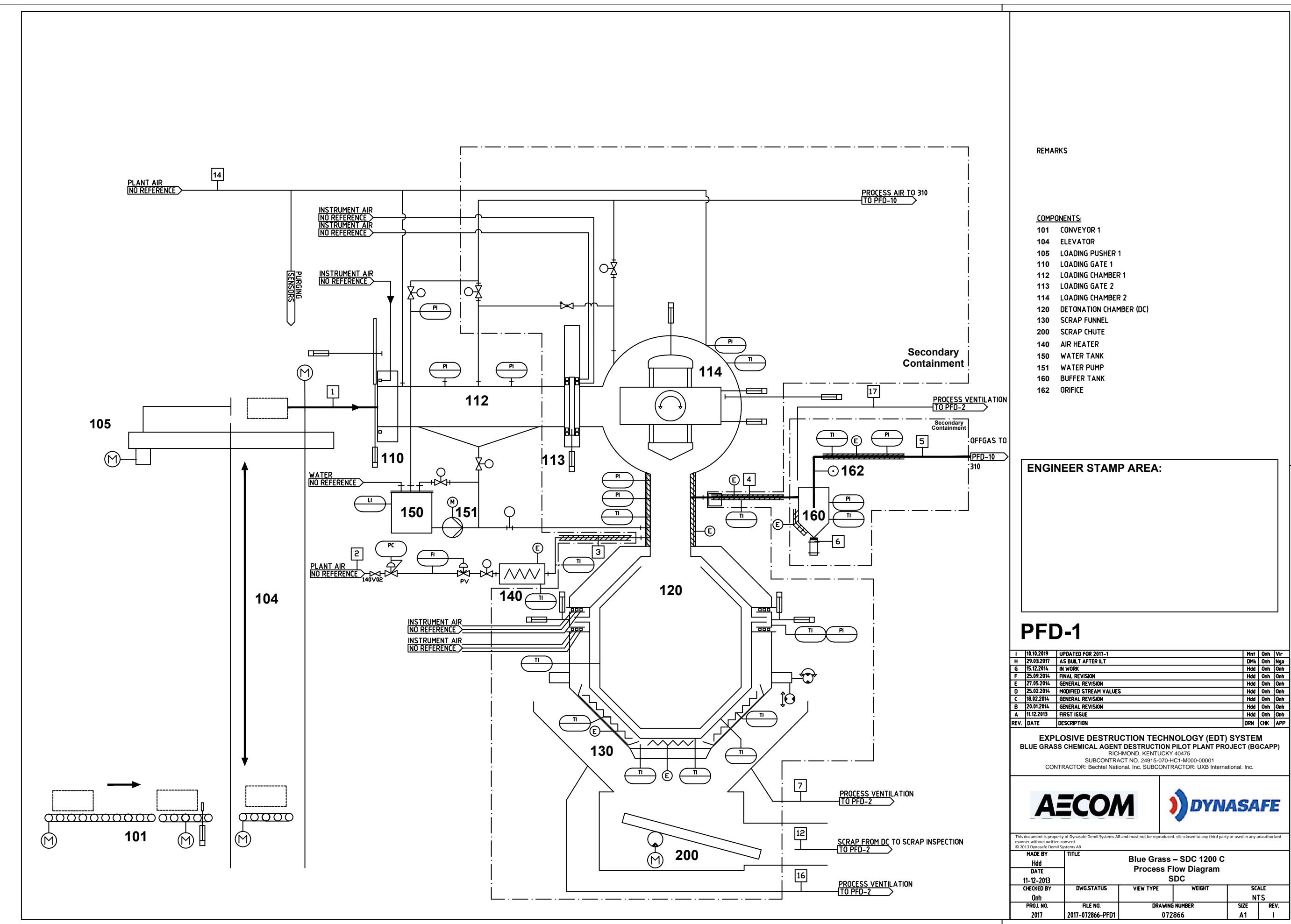
INPUT SPECIES (9) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 58 Inlet IONEX	60.000		74.891	2035.110	1678.588	79.86	-4836.74				
N2(g)	60.000		49.910	1398.135	1118.652	50.90	50.90	1.020	1.020	28.013	0.001
O2(g)	60.000		6.773	216.729	151.808	6.98	6.98	1.031	1.031	31.999	0.001
CO2(g)	60.000		3.518	154.846	78.862	4.67	-1379.86	1.328	-392.177	44.010	0.002
CO(g)	60.000		0.001	0.038	0.030	0.00	-0.15	1.021	-109.521	28.010	0.001
CH4(g)	60.000		0.000	0.000	0.000	0.00	0.00	1.273	-73.327	16.042	0.001
NO(g)	60.000		0.061	1.833	1.369	0.06	5.58	1.043	91.343	30.006	0.001
HCl(g)	60.000		0.000	0.001	0.001	0.00	0.00	1.019	-91.292	36.461	0.002
SO2(g)	60.000		0.000	0.000	0.000	0.00	0.00	1.423	-295.390	64.064	0.003
P4O10(g)	60.000		0.000	0.000	0.000	0.00	0.00	6.961	-2897.153	283.889	0.013
H2O(g)	60.000		14.628	263.528	327.866	17.24	-3520.19	1.179	-240.647	18.015	0.001
HF(g)	60.000		0.000	0.000	0.000	0.00	0.00	1.020	-272.280	20.006	0.001

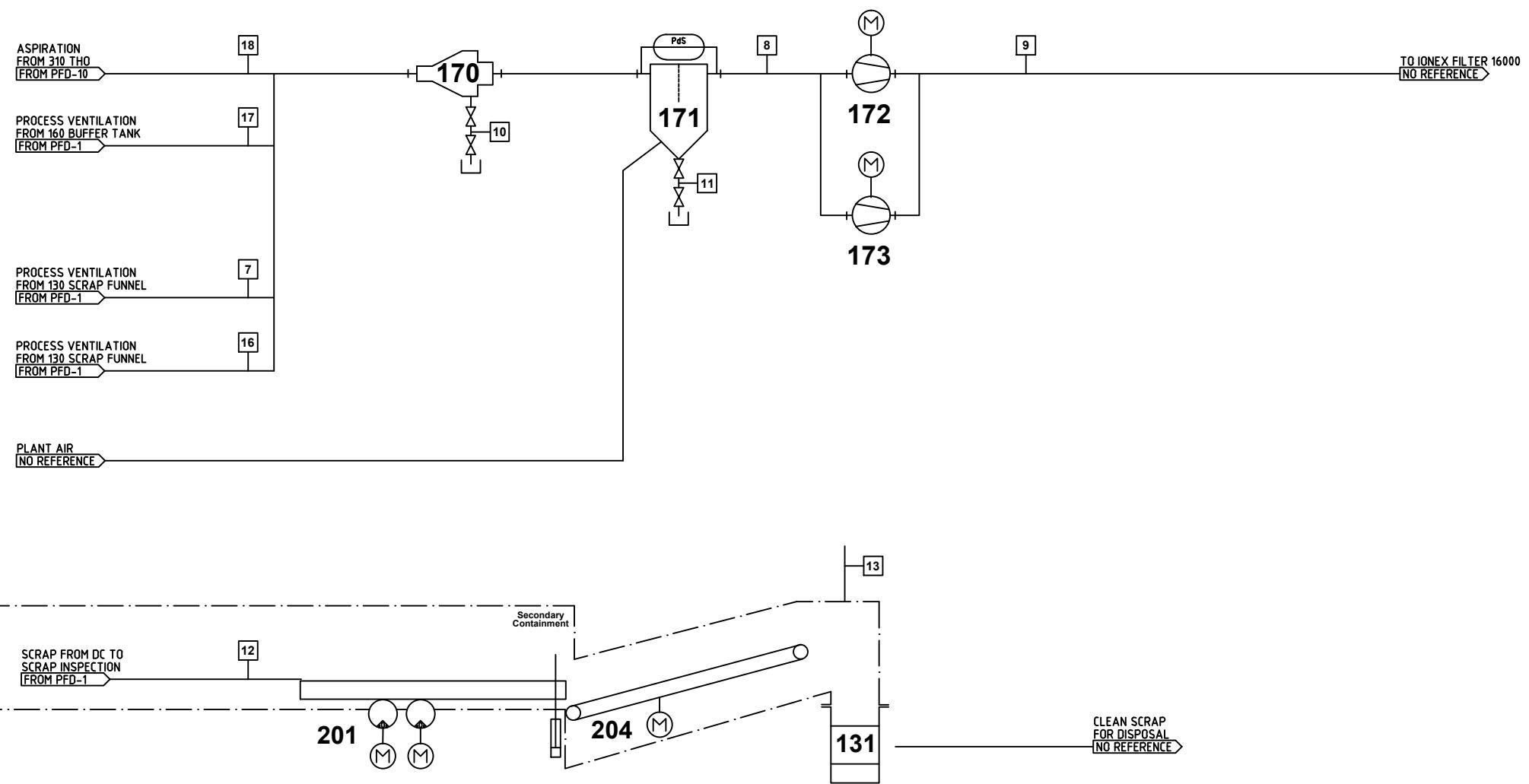
OUTPUT SPECIES (9) Formula	Temper. °C	Pressure bar	Amount kmol	Amount kg	Amount Nm³	Heat Content MJ	Total H MJ	Heat Cont MJ / kmol	Tot H MJ / kmol	MW kg/kmol	Dens kg/l
Stream 59 Outlet IONEX	57.830		74.891	2035.110	1678.588	74.90	-4841.70				
N2(g)	57.830		49.910	1398.135	1118.652	47.74	47.74	0.957	0.957	28.013	0.001
O2(g)	57.830		6.773	216.729	151.808	6.55	6.55	0.967	0.967	31.999	0.001
CO2(g)	57.830		3.518	154.846	78.862	4.38	-1380.16	1.244	-392.261	44.010	0.002
CO(g)	57.830		0.001	0.038	0.030	0.00	-0.15	0.957	-109.584	28.010	0.001
CH4(g)	57.830		0.000	0.000	0.000	0.00	0.00	1.193	-73.407	16.042	0.001
NO(g)	57.830		0.061	1.833	1.369	0.06	5.58	0.979	91.279	30.006	0.001
HCl(g)	57.830		0.000	0.001	0.001	0.00	0.00	0.956	-91.355	36.461	0.002
SO2(g)	57.830		0.000	0.000	0.000	0.00	0.00	1.333	-295.480	64.064	0.003
P4O10(g)	57.830		0.000	0.000	0.000	0.00	0.00	6.514	-2897.600	283.889	0.013
H2O(g)	57.830		14.628	263.528	327.866	16.17	-3521.26	1.105	-240.721	18.015	0.001
HF(g)	57.830		0.000	0.000	0.000	0.00	0.00	0.957	-272.343	20.006	0.001
Fe2O3	57.830		0.000	0.000	0.000	0.00	0.00	3.526	-821.256	159.688	5.240
Heat Loss:						5.00	5.00				

Annex: Mass balance Block Diagram SDC 1200 OTS

Block diagram





COMPONENTS:

- 201 SCRAP CONVEYOR 1
- 204 SCRAP INSPECTION CONVEYOR
- 131 SCRAP BOX
- 170 PROCESS VENTILATION CYCLONE
- 171 PROCESS VENTILATION FILTER
- 172 PROCESS VENTILATION FAN 1
- 173 PROCESS VENTILATION FAN 2

ENGINEER STAMP AREA:**PFD-2**

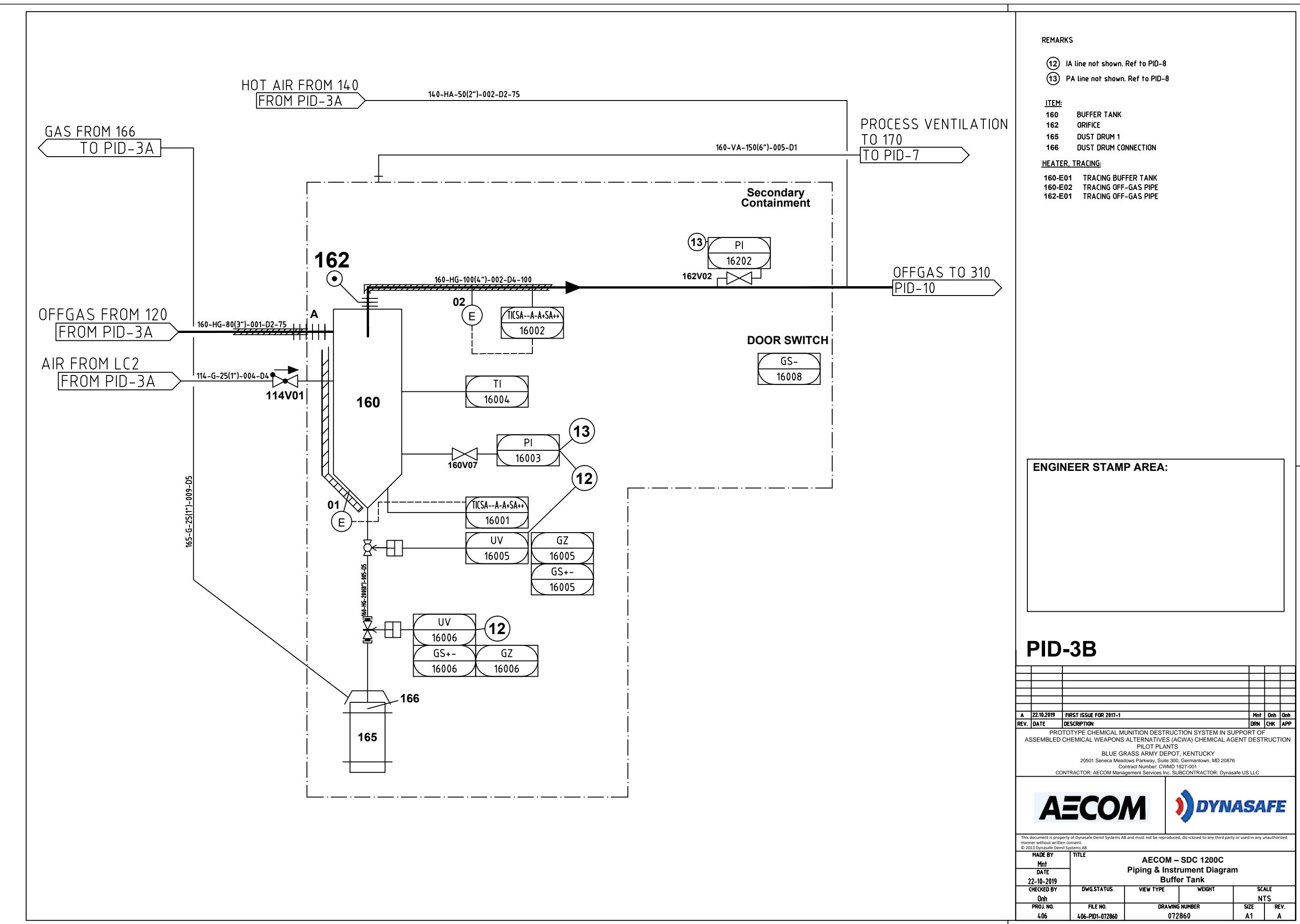
I	REV.	DATE	DESCRIPTION	Mnt	Onh	Vir
I	18.10.2019		UPDATED FOR 2017-1			
H	29.03.2017		AS BUILT AFTER ILT	Dm&	Onh	Nga
G	15.12.2016		IN WORK	Hdd	Onh	Onh
F	25.09.2016		FINAL REVISION	Hdd	Onh	Onh
E	27.05.2016		GENERAL REVISION	Hdd	Onh	Onh
D	25.02.2016		MODIFIED STREAM VALUES	Hdd	Onh	Onh
C	18.02.2016		GENERAL REVISION	Hdd	Onh	Onh
B	20.01.2016		GENERAL REVISION	Hdd	Onh	Onh
A	11.12.2015		FIRST ISSUE	Hdd	Onh	Onh
REV.	DATE		DESCRIPTION	DRW	CHK	APP

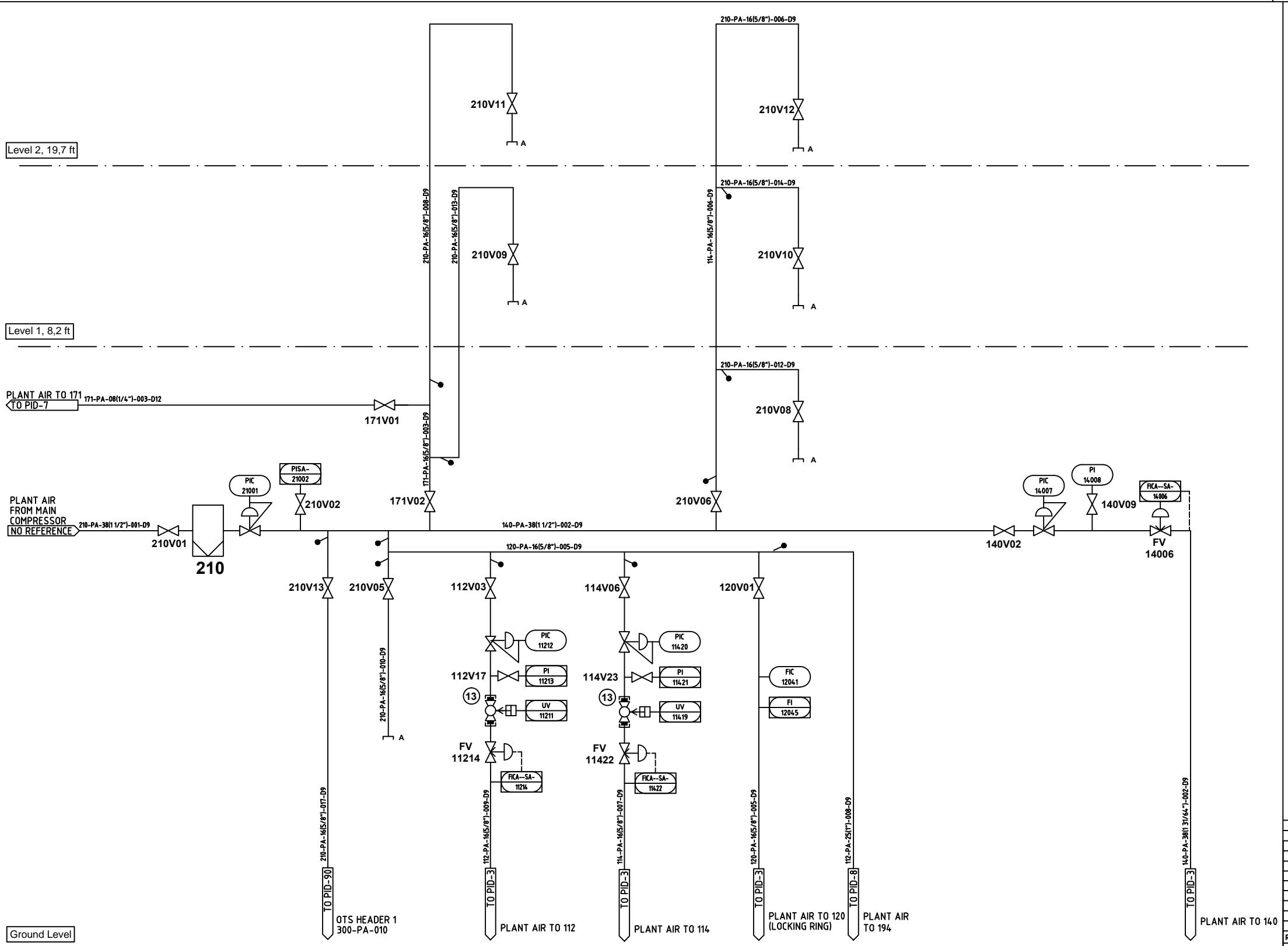
EXPLOSIVE DESTRUCTION TECHNOLOGY (EDT) SYSTEM
BLUE GRASS CHEMICAL AGENT DESTRUCTION PILOT PLANT PROJECT (BGCAPP)
RICHMOND, KENTUCKY 40475
SUBCONTRACT NO. 24915-070-HC1-M000-00001
CONTRACTOR: Bechtel National, Inc. SUBCONTRACTOR: UXB International, Inc.



MADE BY		TITLE		
Hdd		Blue Grass - SDC 1200 C		
DATE		Process Flow Diagram		
11-12-2013		SDC		
CHECKED BY	DWG STATUS	VIEW TYPE	WEIGHT	SCALE
Onh				NTS
PROJ. NO.	FILE NO.	DRAWING NUMBER	SIZE	REV.
2017	2017-072866-PFD2	072867	A1	I

This document is property of Dynasafe Demil Systems AB and must not be reproduced, disclosed to any third party or used in any unauthorized manner without written consent.
© 2013 Dynasafe Demil Systems AB





MARKS

(3) IA LINE NOT SHOWN ON PID-4 FOR CLARITY
REFERENCE TO PID-8

COMPONENTS:

210 AIRFILTER

ENGINEER STAMP AREA:

ID-4

2019	UPDATED FOR 2017-1	Mnt	Onh	Onh
2017	AS BUILT AFTER ILT	Dm&	Onh	Nga
.2015	MINOR CHANGES	Pkp	Onh	Onh
.2015	MINOR REVISION	Pkp	Onh	Onh
.2014	IN WORK	Hdd	Onh	Onh
.2014	FINAL REVISION	Hdd	Onh	Onh
.2014	GENERAL REVISION	Hdd	Onh	Onh
.2014	GENERAL REVISION	Hdd	Onh	Onh
.2014	GENERAL REVISION	Hdd	Onh	Onh
.2014	GENERAL REVISION AND PIPE NUMBERS	Hdd	Onh	Onh
.2013	FIRST ISSUE	Hdd	Onh	Onh
	DESCRIPTION	Dpm	Clik	App

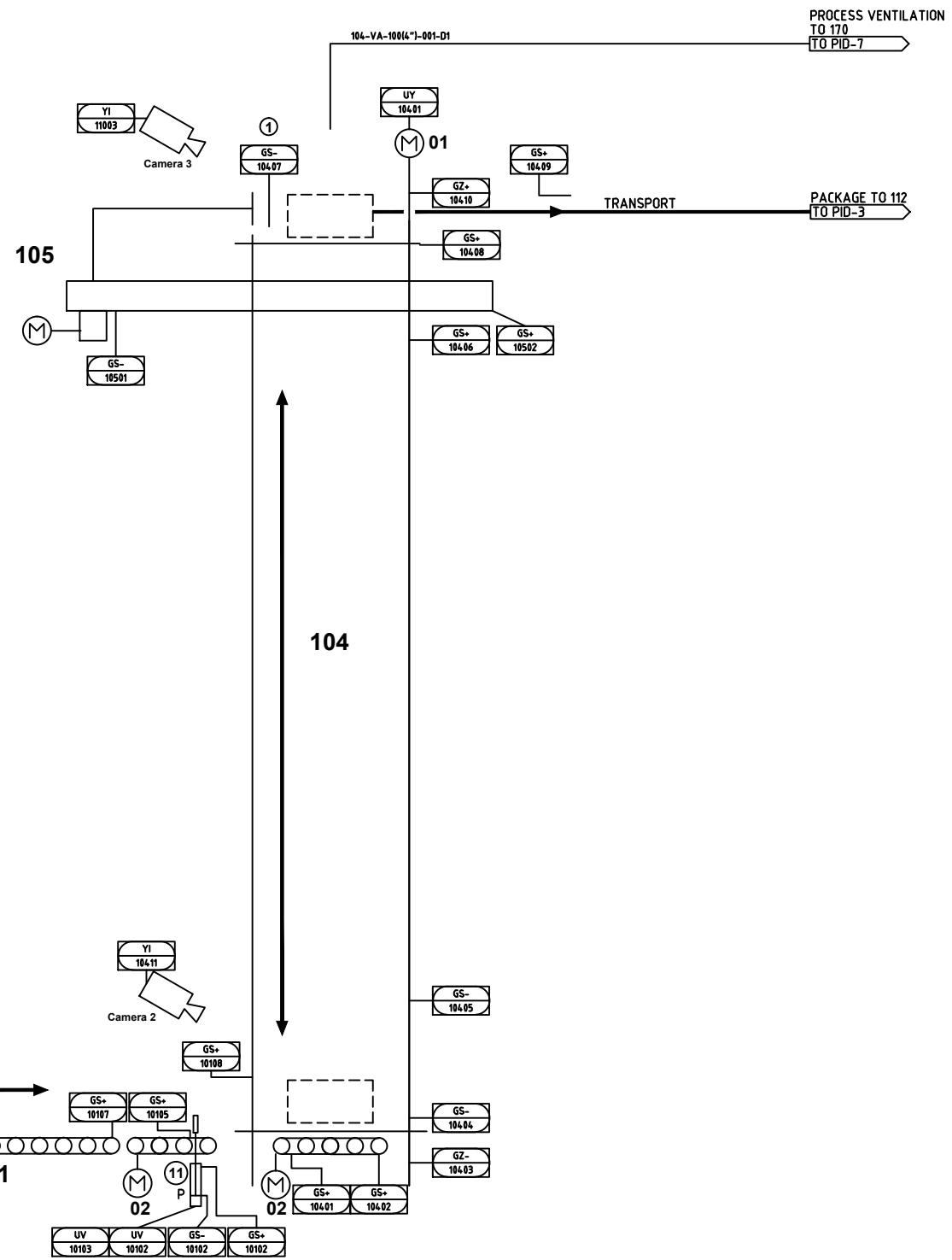
DESCRIPTION PROTOTYPE CHEMICAL MUNITION DESTRUCTION SYSTEM IN SUPPORT OF
ASSEMBLED CHEMICAL WEAPONS ALTERNATIVES (ACWA) CHEMICAL AGENT DESTRUCTION
PILOT PLANTS
BLUE GRASS ARMY DEPOT, KENTUCKY
20501 Seneca Meadows Parkway, Suite 300, Germantown, MD 20876
Contract Number: CWMD 1827-01
CONTRACTOR: AFSCM Management Company, Inc. **CO-CONTRACTOR:** Battelle U.S. Inc.

AECOM |  **DYNASAFE**

ent is property of Dynasafe Demil Systems AB and must not be reproduced, disclosed to any third party or used in any unauthorized manner without written consent.

RE BY	TITLE	AECOM – SDC 1200 C			
ld		Piping & Instrument Diagram			
TE		Plant Air			
2013					
ED BY	DWG STATUS	VIEW TYPE	WEIGHT	SCALE NTS	
h					
NO.	FILE NO.	DRAWING NUMBER		SIZE	REV.
6	406-PID-01-072861	072861		A1	K

GENERAL	COMPONENTS	COMPONENTS	VALVES	VALVE ACTUATOR	SYMBOLS ACCORDING TO DIN 19227																																																																								
					Reference to document number 070158 "Position Numbering and Codification System"																																																																								
PIPING, CONNECTIONS																																																																													
COMPONENTS																																																																													
INSTRUMENTS																																																																													
LETTER CODE INSTRUMENTS																																																																													
INSTRUMENTS																																																																													
ENGINEER STAMP AREA:																																																																													
PID-1																																																																													
<table border="1"> <thead> <tr> <th>J</th><th>16.01.2020</th><th>UPDATED FOR 2017-1, NO OTHER CHANGES</th><th>Mnt</th><th>Onh</th><th>Onh</th></tr> <tr> <th>I</th><th>29.03.2017</th><th>AS BUILT AFTER ILT</th><th>Dfk</th><th>Onh</th><th>Nga</th></tr> <tr> <th>H</th><th>19.02.2015</th><th>MINOR CHANGES</th><th>Pkp</th><th>Onh</th><th>Onh</th></tr> <tr> <th>G</th><th>15.12.2014</th><th>IN WORK</th><th>Hdd</th><th>Onh</th><th>Onh</th></tr> <tr> <th>F</th><th>25.09.2014</th><th>FINAL REVISION</th><th>Hdd</th><th>Onh</th><th>Onh</th></tr> <tr> <th>E</th><th>02.07.2014</th><th>GENERAL REVISION</th><th>Hdd</th><th>Onh</th><th>Onh</th></tr> <tr> <th>D</th><th>27.05.2014</th><th>GENERAL REVISION</th><th>Hdd</th><th>Onh</th><th>Onh</th></tr> <tr> <th>C</th><th>18.02.2014</th><th>GENERAL REVISION</th><th>Hdd</th><th>Onh</th><th>Onh</th></tr> <tr> <th>B</th><th>20.01.2014</th><th>GENERAL REVISION AND PIPE NUMBERS</th><th>Hdd</th><th>Onh</th><th>Onh</th></tr> <tr> <th>A</th><th>11.12.2013</th><th>FIRST ISSUE</th><th>Hdd</th><th>Onh</th><th>Onh</th></tr> <tr> <th>REV.</th><th>DATE</th><th>DESCRIPTION</th><th>DRW</th><th>CHK</th><th>APP</th></tr> </thead> <tbody> <tr> <td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> <p>EXPLOSIVE DESTRUCTION TECHNOLOGY (EDT) SYSTEM BLUE GRASS CHEMICAL AGENT DESTRUCTION PILOT PLANT PROJECT (BGCPP) RICHMOND, KENTUCKY 40475 SUBCONTRACT NO. 24915-070-HC1-M000-00001 CONTRACTOR: Bechtel National, Inc. SUBCONTRACTOR: UXB International, Inc.</p>						J	16.01.2020	UPDATED FOR 2017-1, NO OTHER CHANGES	Mnt	Onh	Onh	I	29.03.2017	AS BUILT AFTER ILT	Dfk	Onh	Nga	H	19.02.2015	MINOR CHANGES	Pkp	Onh	Onh	G	15.12.2014	IN WORK	Hdd	Onh	Onh	F	25.09.2014	FINAL REVISION	Hdd	Onh	Onh	E	02.07.2014	GENERAL REVISION	Hdd	Onh	Onh	D	27.05.2014	GENERAL REVISION	Hdd	Onh	Onh	C	18.02.2014	GENERAL REVISION	Hdd	Onh	Onh	B	20.01.2014	GENERAL REVISION AND PIPE NUMBERS	Hdd	Onh	Onh	A	11.12.2013	FIRST ISSUE	Hdd	Onh	Onh	REV.	DATE	DESCRIPTION	DRW	CHK	APP						
J	16.01.2020	UPDATED FOR 2017-1, NO OTHER CHANGES	Mnt	Onh	Onh																																																																								
I	29.03.2017	AS BUILT AFTER ILT	Dfk	Onh	Nga																																																																								
H	19.02.2015	MINOR CHANGES	Pkp	Onh	Onh																																																																								
G	15.12.2014	IN WORK	Hdd	Onh	Onh																																																																								
F	25.09.2014	FINAL REVISION	Hdd	Onh	Onh																																																																								
E	02.07.2014	GENERAL REVISION	Hdd	Onh	Onh																																																																								
D	27.05.2014	GENERAL REVISION	Hdd	Onh	Onh																																																																								
C	18.02.2014	GENERAL REVISION	Hdd	Onh	Onh																																																																								
B	20.01.2014	GENERAL REVISION AND PIPE NUMBERS	Hdd	Onh	Onh																																																																								
A	11.12.2013	FIRST ISSUE	Hdd	Onh	Onh																																																																								
REV.	DATE	DESCRIPTION	DRW	CHK	APP																																																																								
<p>BECHTEL PARSONS A Joint Venture of Bechtel National, Inc. and Parsons Environmental Services, Inc.</p> <p>UXB</p> <p>DYNASAFE</p> <p>This document is property of Dynasafe Demil Systems AB and must not be reproduced, disclosed to any third party or used in any unauthorized manner without written consent. © 2013 Dynasafe Demil Systems AB</p> <table border="1"> <thead> <tr> <th>MADE BY</th><th>DATE</th><th colspan="3">TITLE</th></tr> <tr> <th>Hdd</th><th>11-12-2013</th><th colspan="3">Blue Grass - SDC 1200 C</th></tr> <tr> <th></th><th></th><th colspan="3">Piping & Instrument Diagram Symbols and Nomenclature</th></tr> <tr> <th>CHECKED BY</th><th>DWG STATUS</th><th>VIEW TYPE</th><th>WEIGHT</th><th>SCALE</th></tr> <tr> <td>Onh</td><td>406</td><td>406-PID-072858</td><td>072858</td><td>NTS</td></tr> <tr> <td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>PROJ. NO.</td><td>FILE NO.</td><td>DRAWING NUMBER</td><td>SIZE</td><td>REV.</td></tr> <tr> <td>406</td><td>406-PID-072858</td><td>072858</td><td>A1</td><td>J</td></tr> </thead></table>						MADE BY	DATE	TITLE			Hdd	11-12-2013	Blue Grass - SDC 1200 C					Piping & Instrument Diagram Symbols and Nomenclature			CHECKED BY	DWG STATUS	VIEW TYPE	WEIGHT	SCALE	Onh	406	406-PID-072858	072858	NTS						PROJ. NO.	FILE NO.	DRAWING NUMBER	SIZE	REV.	406	406-PID-072858	072858	A1	J																																
MADE BY	DATE	TITLE																																																																											
Hdd	11-12-2013	Blue Grass - SDC 1200 C																																																																											
		Piping & Instrument Diagram Symbols and Nomenclature																																																																											
CHECKED BY	DWG STATUS	VIEW TYPE	WEIGHT	SCALE																																																																									
Onh	406	406-PID-072858	072858	NTS																																																																									
PROJ. NO.	FILE NO.	DRAWING NUMBER	SIZE	REV.																																																																									
406	406-PID-072858	072858	A1	J																																																																									

**REMARKS**

- (1) POSITION SENSOR ONLY FOR REVERSE TRANSPORT IN CASE OF A PROBLEM
- (11) IA LINE NOT SHOWN ON PID-2 FOR CLARITY
REFERENCE TO PID-8

COMPONENTS:

101 CONVEYOR 1
104 ELEVATOR
105 LOADING PUSHER 1

HORN:
101-H01**LOCAL OPERATOR PANEL:**
A071**ENGINEER STAMP AREA:****PID-2**

J	16.01.2020	UPDATED FOR 2017-1, NO OTHER CHANGES	Mnt	Onh	Onh
I	29.03.2017	AS BUILT AFTER ILT	Dm	Onh	Nga
H	19.08.2015	MINOR CHANGES	Pkp	Onh	Onh
G	15.12.2014	IN WORK	Hdd	Onh	Onh
F	25.09.2014	FINAL REVISION	Hdd	Onh	Onh
E	02.07.2014	GENERAL REVISION	Hdd	Onh	Onh
D	27.05.2014	GENERAL REVISION	Hdd	Onh	Onh
C	18.02.2014	GENERAL REVISION	Hdd	Onh	Onh
B	20.01.2014	GENERAL REVISION AND PIPE NUMBERS	Hdd	Onh	Onh
A	11.12.2013	FIRST ISSUE	Hdd	Onh	Onh
REV.	DATE	DESCRIPTION	DRW	CHK	APP

**EXPLOSIVE DESTRUCTION TECHNOLOGY (EDT) SYSTEM
BLUE GRASS CHEMICAL AGENT DESTRUCTION PILOT PLANT PROJECT (BGCAPP)**

RICHMOND, KENTUCKY 40475

SUBCONTRACT NO. 24915-070-HC1-M000-00001

CONTRACTOR: Bechtel National, Inc. SUBCONTRACTOR: UXB International, Inc.



This document is property of Dynasafe Demil Systems AB and must not be reproduced, disclosed to any third party or used in any unauthorized manner without written consent.
© 2013 Dynasafe Demil Systems AB

MADE BY	TITLE
Hdd	Blue Grass – SDC 1200 C
Piping & Instrument Diagram	
DATE	Conveyor System
11-12-2013	
CHECKED BY	DWG STATUS
Onh	VIEW TYPE
	WEIGHT
	SCALE
	NTS
PROJ. NO.	FILE NO.
406	DRAWING NUMBER
	072859
SIZE	REV.
A1	J

COMPONENT NO.	101	104	105						
NAME	CONVEYOR 1	ELEVATOR	LOADING PUSHER 1						
MEDIUM	Roller Conveyor	Elevator	Pusher						
	0.37 kW + 0.37 kW	15 + 0.37 kW	0.55 kW						
TECHNICAL DATA	0.5hp + 0.5hp	2 + 0.5 hp	0.75hp						
	8 m/min	15 m/min	15 m/min						
	26 ft/min	49 ft/min	49 ft/min						
DESIGN PRESSURE	bar g	-	-						
	psi g	-	-						
DESIGN TEMPERATURE	°C	Ambient	Ambient	Ambient					
	°F	Ambient	Ambient	Ambient					
MATERIAL	Mild Steel	Mild Steel	Mild Steel						
REMARKS	12 Boxes accumulated	-	Electric operated						

